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THE FOREST

A HANDBOOK FOR TEACHERS

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OUR FRIEND THE FOREST

" Yon clear spring, that, amidst the herbs, wells softly forth and visits the strong roots of half the mighty forest, tells no tale of all the good it does "

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THE FOREST: A HANDBOOK FOR TEACHERS

By D. Priscilla Edgerton, *Educational Specialist, Forest Service*

INTRODUCTION

The forest is a living and active community; it abounds in forms of vegetable and animal life; it is full of the wonderful and the beautiful; it is teeming with lessons of interest at all seasons of the year; and, what is most important from a practical viewpoint, the material for these lessons is accessible to almost everyone. Individual trees furnish interesting and instructive features; but the broader study of the forest, although frequently neglected in the study of single trees, offers untold opportunities not only for

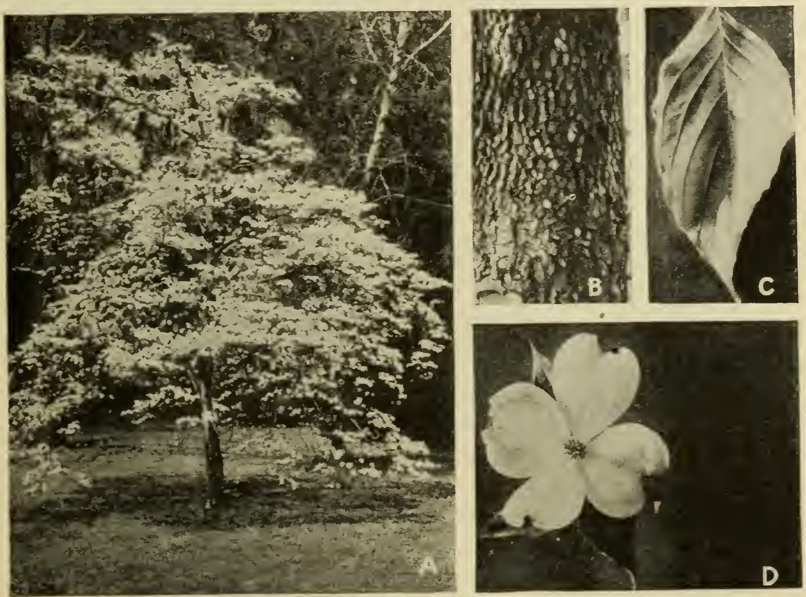

FIG. 1.—The bride of the woods

The flowering dogwood is valued for beauty and for practical use. It is a favorite in landscape gardening, and the hardness of its wood adapts it to the manufacture of articles such as tool handles, shuttle blocks, hubs, cogs, and engraving blocks. A, the tree. B, the bark. C, the leaf. D, the flower.

NOTE.—The inspiration for this little handbook and much of the material upon which it is based were drawn from Farmers' Bulletin 468, by Edwin R. Jackson. That publication is now out of print, and there has been a growing need in the educational field for something to fill its place. It has therefore been rewritten in conformity with the newer methods of correlating the subject with other studies. Work for seventh, eighth, and ninth grades, or junior high school classes, and considerable supplementary material have been added, and the entire course of lessons has been rearranged.

useful instruction but also for developing and holding the interest of pupils and for training them to keenness of observation.

The studies outlined in this circular need not be given as continuous lessons, but may be taken up at various times during the year as opportunity offers. Possibly one period out of every three or four devoted to nature study, language, geography, manual training, or general science may be given with profit to the study of the forest. This outline is in no sense intended to suggest that the study of the forest should supplant any other subject; it merely points out some of the interesting and useful things about the forest which every child should know if he is to become a well-informed useful citizen. In the lower grades even, if there is no special nature-study course, tree study with an occasional glimpse into the forest (fig. 1) should be introduced. In the intermediate grades the study of the forest is correlated with geography. In the high school it properly has a place as part of elementary agriculture. In high schools where agriculture is not taught as a distinct subject a great deal of study of the forest may be included with such subjects as physical geography, botany, and manual training.

The best way to teach the subject is to take the pupils to the woods. When this is impossible, specimens and exhibits should be brought into the schoolroom for study. If trees are not accessible for study, the next best thing, perhaps, is a set of well-selected pictures which show forest conditions and various features of tree growth. Such pictures may frequently be found in magazines, geographies, and nature books. The camera is an unfailing source of interest and instruction. If one can be carried by pupil or teacher on excursions to the woods the interesting things seen there can be photographed, and the prints labeled with descriptions telling something that has been learned about the subject. These pictures may be pasted in an album or on a "forest calendar," to become the permanent possession of the school.

The most important requirement for success in such work is the advance preparation of the lesson by the teacher. If a field trip is to be undertaken, the teacher should learn in advance where the class can go to the best advantage and what may be expected from the trip. If specimens are to be collected, the teacher should know whether the material desired is available in the vicinity and how it can most easily be obtained. If an experiment is to be performed, the teacher should go over the details carefully, and if possible perform the experiment in advance, so as to know what results to expect and what difficulties and sources of error the pupils are likely to encounter. Nothing will be more disastrous to an undertaking of this sort than the lack of a definite plan of work on the part of the teacher; without it the field trip degenerates into a picnic for the pupils and a tragedy for the teacher.

The material in this bulletin is arranged for intermediate and junior high-school grades, with preparatory seasonal suggestions for the use of the teacher whose pupils have had little or no nature-study work in the primary grades. Even where such work is well organized, it may be helpful to the fifth-grade teacher to review the preliminary seasonal outlines at the beginning of each season before taking up the more definite study of the forest and the usefulness of the forest to man.

PRELIMINARY SEASONAL OUTLINES FOR PRIMARY GRADES

The outlines given in this manual are necessarily very general in character. If they are to be of practical use the teacher MUST LOCALIZE THE LESSONS. If the trees named for study are not to be found in the neighborhood, others must be chosen from the local forest flora. Exercises and experiments should be modified to suit local conditions.

FALL PRELIMINARY

Leaves of Autumn.—Study autumn leaves or shrubs common to the locality and use them in classroom decoration and in color work.

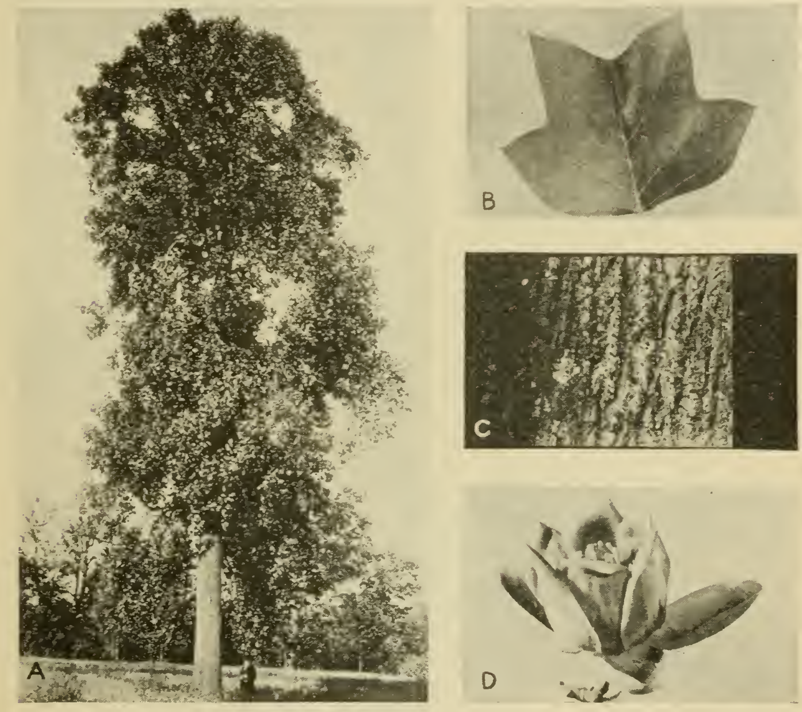

FIG. 2.—A real American tree

The tulip tree, or yellow poplar of commerce, is a great favorite as a shade tree and one of the most valuable timber trees of the eastern United States. A, the tree. B, the leaf. C, the bark. D, the flower.

Select for fall study one or more of the following tree or shrub species, the most conspicuous for brilliant foliage at this season: Maple, oak, elm, chestnut,[1] sassafras, catalpa, willow, basswood, yellow poplar (tulip tree) (fig. 2), walnut, horse-chestnut, pine, sumach, gingko, Lombardy poplar.

---

[1] The chestnut blight is destroying the chestnut trees of the eastern United States. The teacher or pupil is fortunate who can locate a chestnut tree that has so far escaped the blight.

Discuss the life work of the leaves. All summer long the tree breathes through the leaves and stores up food and drink in them. Then the tree gets ready to sleep comfortably for the winter. Its sap ceases to flow, and all its energies relax in twig and branch and trunk. So the work of the leaves is done and they must go.

Bright yellow, red, and orange,
The leaves come down in hosts.

Suggestions for supplementary readings:

How the Leaves Came Down.—Susan Coolidge. (Nature in Verse; Classic Verses for Little Ones: Posy Ring.)

The Anxious Leaf.—Henry Ward Beecher. (Classic Stories for Little Ones; Little Flower Folk.)

Nuts and Fruits of Forest Trees.—Gather for study small branches bearing nuts, cones, or seed pods. As far as possible connect the study of nuts with the leaf studies and learn to identify as many trees as possible by their fruits: Hickory, walnut, beech, oak, horse-chestnut, chestnut, catalpa, locust, crab apple, wild plum, pine, and hemlock.

The tree world has no greater source of interest and instruction than the variety and ingenuity of its fruit forms. Children are enthusiastic collectors and comparers of the acorns of the various oaks; the dainty keys of the maples and ashes; the pods of the locust; the winged seeds of elms and birches; the nuts of hickory, beech, walnut, and chestnut; and the cones of pines and other conifers.

Carefully remove the shell from an acorn and examine the kernel. Into how many parts is it divided? Separate them and see if you can find the little "sprout" hidden between them. Explain that the kernel of the nut is really the seed of the tree. Now compare the seeds of the locust or catalpa in their pods with those of the apple and plum in their fleshy coverings.

Suggestions for supplementary readings:

Little Nut People.—Nichelson. (Nature in Verse.)
The Gossip of the Nuts.—Selected. (Nature in Verse.)

The Whole Tree.—Use chart, "How the tree grows" (fig. 3).

A tree consists of three parts—roots, trunk, and crown. The roots hold the tree in place and absorb water and food from the ground. The trunk supports the crown, and through it the water and food which the roots have taken from the soil are drawn to the crown. The crown, consisting of branches and leaves, digests this food and also other kinds of food which the leaves take in from the air.

Renew acquaintance with trees already studied and add some new types, such as the ash, aspen, hackberry, mulberry, and sweet gum.

Learn the meaning of the following terms and apply them to some chosen tree: Roots; stem, bole, or trunk; bark; sap; branch; spray; twig; leaf; petiole; foliage.

Suggestions for supplementary readings:

Our Trees and How to Know Them.—Emerson and Weed.
Trees Worth Knowing.—Rogers.

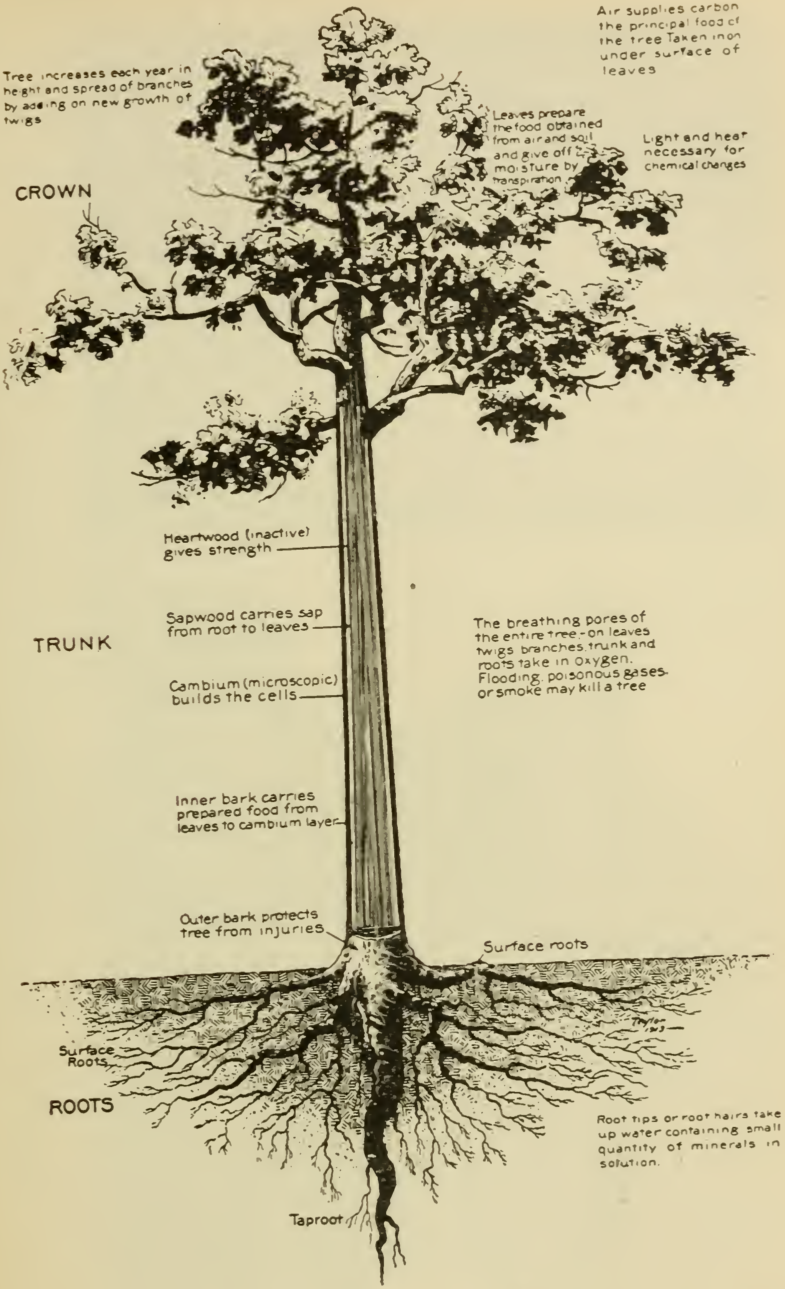
Tree increases each year in height and spread of branches by adding on new growth of twigs
Air supplies carbon the principal food of the tree Taken in on under surface of leaves
Leaves prepare the food obtained from air and soil and give off moisture by transpiration
Light and heat necessary for chemical changes
CROWN
Heartwood (inactive) gives strength
Sapwood carries sap from root to leaves
TRUNK
The breathing pores of the entire tree,-on leaves twigs branches, trunk and roots take in oxygen. Flooding, poisonous gases or smoke may kill a tree
Cambium (microscopic) builds the cells
Inner bark carries prepared food from leaves to cambium layer
Outer bark protects tree from injuries
Surface roots
Taylor
Surface Roots
ROOTS
Root tips or root hairs take up water containing small quantity of minerals in solution.
Taproot

FIG. 3.—How the tree grows

The buds, root tips, and cambium layer are the growing parts of the tree. Water containing a small quantity of minerals in solution is absorbed by the roots, carried up through the sapwood to the leaves, and there combined with carbon from the air to make food. This food is carried by the inner bark to all growing parts of the tree, even down to the root tips.

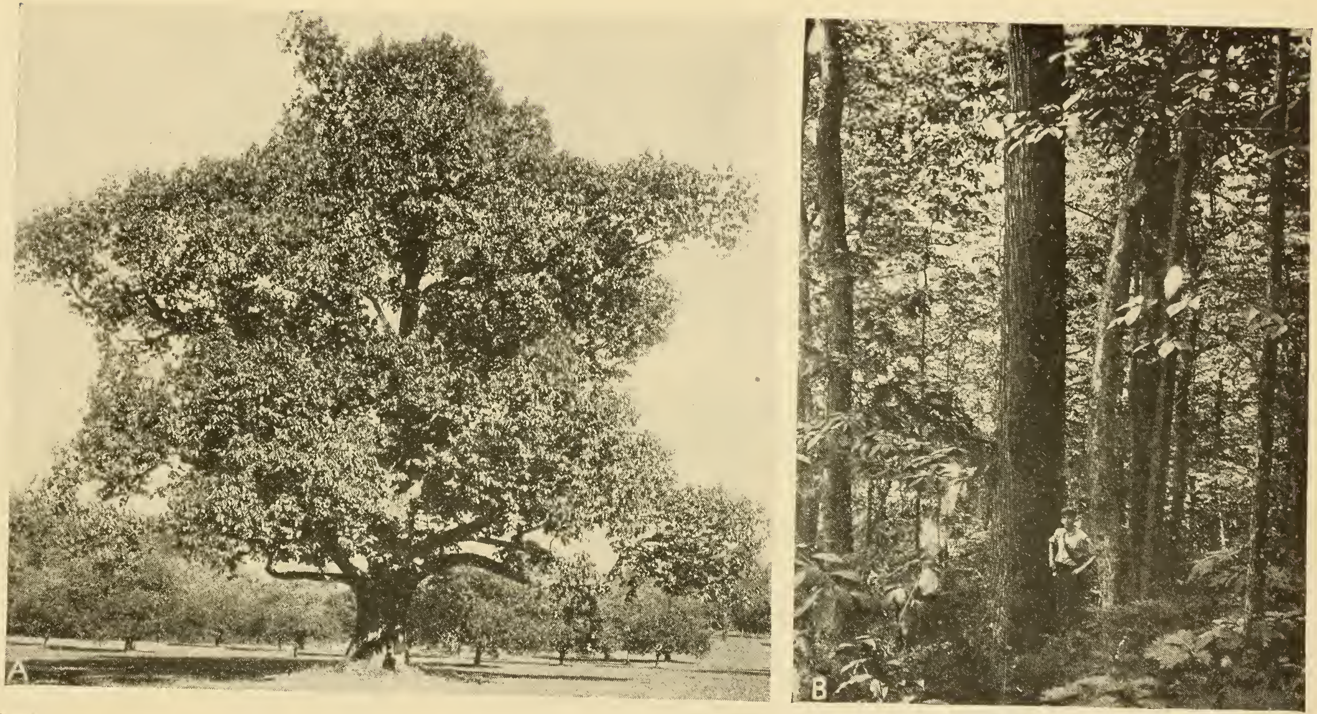

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FIG. 4.—The give and take of the forest

Individual chestnut growing in the open (A), with wide-spreading branches, contrasted with an individual chestnut of forest growth (B). In the struggle for space and light such forest-grown trees send up long, straight trunks, with high, bushy crowns, which finally reach the sunlight by overtopping their neighbors. The branches of the forest trees' earlier growth are naturally pruned off by lack of sunlight and other conditions unfavorable to a spreading growth.

Tree Families and Communities, the Forest.—The history of the life of a forest is a story of how trees help and harm each other (fig. 4). Where many trees are growing together not all of them can get as much light, water, and food as they need, and each struggles with its neighbors for a larger share of these three things upon which tree life depends. On the other hand, in the forests the decay of fallen leaves enriches the earth, the branches and roots of the trees prevent rains from washing the fertile soil away, and the shade cast on the earth helps to keep it moist; so that although each forest tree fights to get for itself the largest possible share of the available supply of food, it is at the same time helping to improve and preserve this supply.

Study and compare two or more of the following sets of trees as to characteristics and habits: Silver maple and sugar maple; chestnut oak and scarlet oak; American elm and slippery elm; pignut hickory and shagbark hickory; spruce and hemlock; paper birch and river birch; long-leaf pine and sugar pine.

Learn to know all the members of some tree family (as all the maples) found in the vicinity. Collect and mount the leaves for comparison. Visit the woods if possible. Notice how the trees form a sort of canopy or roof with their branches and leaves. Observe the "under story" of sprouts, seedlings, and small plants.

Suggestions for supplementary readings:

The Story of the Forest.—Dorrance.
Myths and Legends of Flowers, Trees, and Plants.—Skinner.

WINTER PRELIMINARY

Broadleaf Trees in Their Winter Sleep.—In preparation for the tree's winter sleep, the supply of food and water taken up by its roots is gradually lessened. The flow of sap from the roots grows weaker; out of a job, the leaves drop off; the buds are blanketed and the shoots sheathed.

Just before the buds begin to swell with the approach of spring, bring or have the pupils bring twigs with large buds to the schoolroom and put them in water. Notice how in a few days, if the room is kept warm, the scales begin to open. Watch to see if you can discover the little new leaf folded within the bud. Compare the opened buds with others of the same kind brought from out of doors. Study how the scales protect the young leaf through the winter. Examine the scales. Are they smooth, gummy, or fuzzy? Do you think the down or gum you find on some buds helps to keep the leaves dry and to protect them from the cold?

Study winter buds of the following trees: Horse-chestnut, magnolia, elm, box elder (ash-leafed maple), beech, hickory, cottonwood (Carolina poplar), and basswood (American linden).

Suggestions for supplementary readings:

The Baby Bud's Winter Clothes.—Jarvis. (In the Child's World.)
The Venturesome Buds.—A. C. (Nature in Verse.)

Tree Trunks, Their Coverings and Uses.—The bark is the outer covering or "overcoat" of the tree. It covers the trunk, all the branches, and the roots. It grows in two layers. The outer bark is hard and generally rough, and protects the tree from injury and from heat and cold. The inner bark is moist and soft, and carries the food from the leaf workshops to the growing parts of the tree. The outer bark is formed by the drying and hardening of the inner bark. This drying and hardening, as the inner portions of the tree grow, cause the cracking seen in the bark of most trees. Different trees show this in different ways. Some have long ridges (oak); some have papery layers (birch); others have large flakes (some of the pines); others again are comparatively smooth (as the poplar and beech); some few shed the bark (as the sycamore). The barks of certain trees have important uses. Cork is made from the bark of the cork oak tree; tannin, used in the making of leather, comes from the bark of the hemlock, several oaks, and other trees. The story of Hiawatha tells of a use made of the bark of another tree:

> Give me of your bark, O birch tree!
> Of your yellow bark, O birch tree!
>
> * * * * *
>
> I a light canoe will build me.

Have the pupils study the bark of trees in the vicinity of the school, such as any one or more of the following: Sycamore, shellbark hickory, birch, willow, beech, silver maple, slippery elm, sassafras, black cherry, locust, Osage orange, pine, spruce, and cedar. Have the pupils learn to recognize 8 or 10 such trees by their bark, divide them into groups, etc.

Suggestions for supplementary readings:

Hiawatha's Sailing.—Longfellow.
The Story of a Stick of Wood.—Chase. (Buds, Stems, and Roots. Vol. II.)

Shapes of Trees.—The best time to study the shapes of trees is in winter, when the branches of all but the evergreen trees are leafless. Go into the woods, if possible, and look up. You will be surprised to see how nearly the crowns fill all the space overhead. The large trees have pushed up, struggling to get ahead of each other and to spread their tops in the light, without which their leaves can not digest the food necessary for further growth. The lower branches have been shaded off, and the forest form of the tree has been developed—long, clean trunk, or upward-stretching great branches, with narrow crown lifted high in the air. How different from a tree of the same species grown in the field or park!

Even on the streets or in the school yard you can study tree fashions in winter as well as in full-leaf time. Contrast, for instance, with the graceful elm the dignified Lombardy poplar. These belong to the two great classes of tree growth—one in which the trunk can be traced up through the crown to the topmost twig, and the other in which the trunk divides into branches, with no main central stem through the crown.

Have the pupils study the shapes of trees, such as those listed below, and learn to know them by their form alone: Elm, oak, ash, birch, catalpa, Osage orange, horse-chestnut, Lombardy poplar, weeping willow, pine, Norway maple, and fir.

Suggestions for supplementary readings:

Three Trees.—Selected. (Nature in Verse.)
The Silver Poplars.—Selected. (Stories from Garden and Field. Vol. V.)

The Evergreens.—

If Mother Nature patches the leaves of the trees and vines,
I'm sure she does her darning with the needles of the pines.
They are so long and slender, and somewhere in full view
She has her threads of cobweb and her thimble made of dew.

The cone-bearing trees excel all others in all-around usefulness. They have grace of form and richness of foliage; many of them supply us with more than one useful product; and, with the exception of the larches or tamaracks, and the southern cypress, they are evergreen. What trees do you know whose leaves stay green all the year? What kinds of evergreens do you know that have needle leaves?

The cone-bearing evergreens—the pines, hemlocks, spruces, firs, sequoias, cypresses, cedars, and junipers—belong to the proud old "first families" of the forest. They are the first to take possession of the land. The term "evergreen" applies also to the holly, the magnolias, the laurels, and many oaks.

The best-known evergreen is the pine, which has made possible the progress of man along that highway of civilization, the Temperate Zone, by its many gifts of lumber and other wood products, healing balms, and the healthful environment it creates.

The fir has been called "the best tree in the world" because of its excellence as a Christmas tree.

The spruces are used more than any other trees for making paper.

The giant sequoias are perhaps the oldest trees in the world.

Trees for study: Pine, fir, cedar, spruce, hemlock, larch,[2] live oak, and holly.

Recommend to the children great care in cutting evergreens for decorative purposes, especially the holly, which is of slow growth. Tell them not to tear or strip the twigs off, but to use a knife and make a straight, clean cut, so that the sapling can the more easily heal its wound.

Suggestions for supplementary readings:

Holly.—Susan Hartley. (Nature in Verse.)
A Young Fir Wood.—Rossetti. (Trees in Poetry and Prose; Golden Numbers.)
The Fruit of the Christmas Tree.—Kellerhouse. (Forest Fancies.)

SPRING PRELIMINARY

The Spring Awakening.—

Go and measure to what length the silvery willow catkins have crept out beyond their scales, if you would know what time of the year it is by Nature's clock. (Henry David Thoreau.)

Have the pupils bring in tree flowers of as many kinds as can be found in the neighborhood. Explain that the "tassels" of the oak and the "pussies" of the pussy willows are really flowers.

Encourage study of the blossoms of the following, either by observation or by pictures: Red maple, pussy willow, catalpa, elm, oak, birch, flowering dogwood, wild crab apple tree, yellow poplar (tulip tree), basswood (American linden), magnolia, and horse-chestnut (fig. 5).

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[2] The larch is not an evergreen, but is suggested for study here as a type of cone-bearing tree which loses its leaves in winter.

Why not make a tree calendar? For a beginning, let the pupils bring to school the different tree blossoms as they appear and list the dates for each species. Then make any other form of calendar for which materials are available. (See Supplementary Exercises, p. 51.)

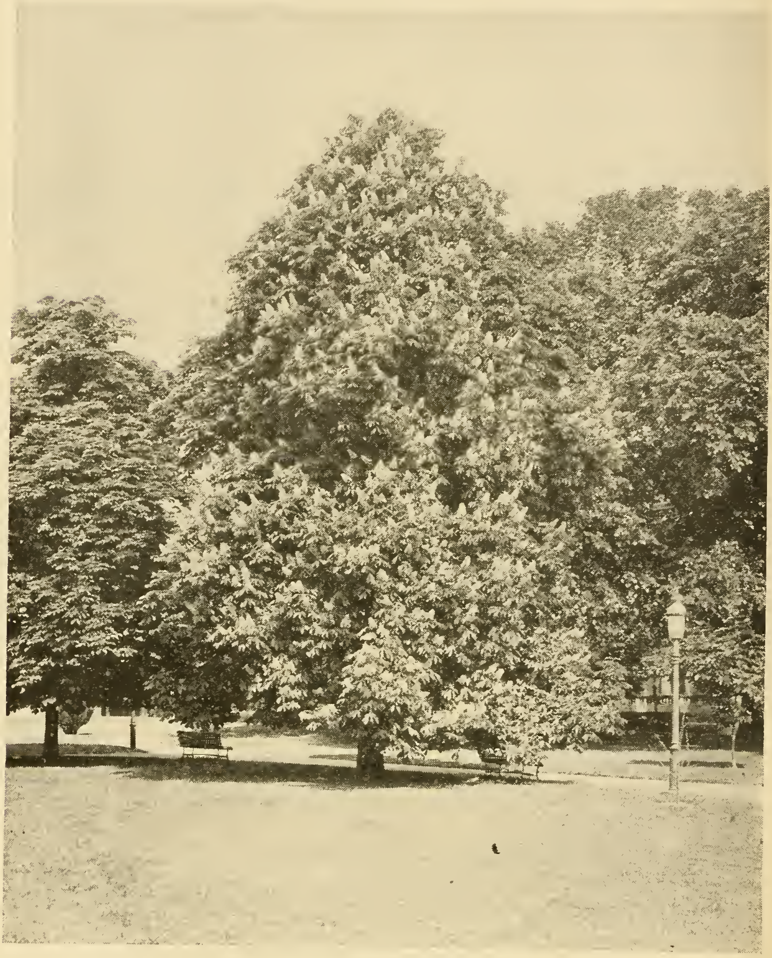

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FIG. 5.—The giant's nosegay

The horse-chestnut, which is becoming more and more familiar in our city parks, is one of the many gifts of Greece to the western world. In England a day is especially set apart for this tree—Horse-chestnut Sunday—an honor bestowed upon no other tree in that country. It is sometimes nicknamed the "hyacinth tree" and sometimes the "giant's nosegay."

Suggestions for supplementary readings:

The Walnut Tree That Wanted to Bear Tulips.—Wiltse. (Kindergarten Stories and Morning Talks.)
Pussy Willow.—Kate L. Brown. (In the Child's World.)
A Sylvan Easter.—Kellerhouse. (Forest Fancies.)

Tree Seeds.—Study the ways in which the different seeds are scattered. Light seeds, like those of the elm, are easily borne far by the wind; but the heavier maple keys are winged to whirl slanting down, and so are sown broadcast about the parent tree.

Sycamore seed balls and spring buds (fig. 6) appear on the naked tree at the same time—the fruiting of the past season and the promise of the one to come. Is this the rule for tree fruit and buds, or is the sycamore an exception? Through the winter and early spring these seed balls break up and the seeds are scattered far and wide by wind and water.

Look for the little seedlings which spring up beneath trees in near-by woods or in the school yard. Dig up one not more than 2 or 3 inches high and look for the remains of the seed from which it started. The seedling should be selected from a number crowding each other. Why? If the seedling is from a thick-shelled nut, such as the hickory or walnut, see if you can find out how the tender little seedling got out of the shell. Tell how "Jack Frost" helped it. Wonderful as it may seem, the food stored up in the seed or nut feeds the little seedling until its roots get started in the soil and its leaves in the air.

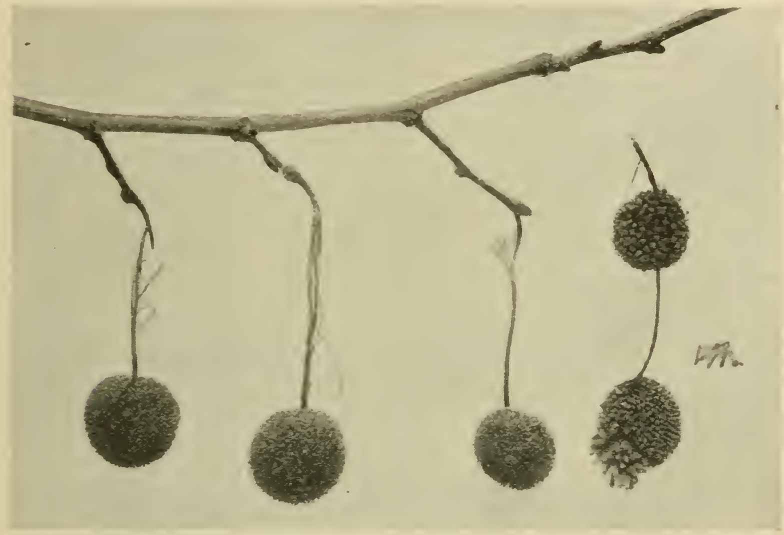

FIG. 6.—Sycamore seed balls and spring buds

The seeds of the following trees either ripen in the spring or may be kept in the school museum or bought at the market, and thus may be ready for study in the spring term: Elm, silver maple, cottonwood (Carolina poplar), oak, catalpa, locust, sycamore, chestnut, walnut, apple, peach, plum, pine, spruce, and balsam fir.

Suggestions for supplementary readings:

See Travelers.—Weed.
The Fly-aways and Other Seed Travelers.—Fultz.

The Growth of the Tree (fig. 7).—

Except in the buds, leaves, fruit, and the twigs less than a year old, new material is deposited in a thin coat over the whole tree between the wood and the bark. The new twigs grow in length by a kind of stretching, but only during the first year. Thus it is only by means of these youngest twigs that a tree increases in height and in spread of branches. After the first year their length is fixed, younger twigs stretch out from the buds, and the older ones grow henceforth only in thickness. The fresh coat of new material covers them year by year. There are two layers in this coat, separated by a third layer of tender forming tissues called "the cambium," in which the actual making of the new substance goes on. The inner side of the cambium layer forms new wood, the outer side new bark. (A Primer of Forestry, by Gifford Pinchot.)

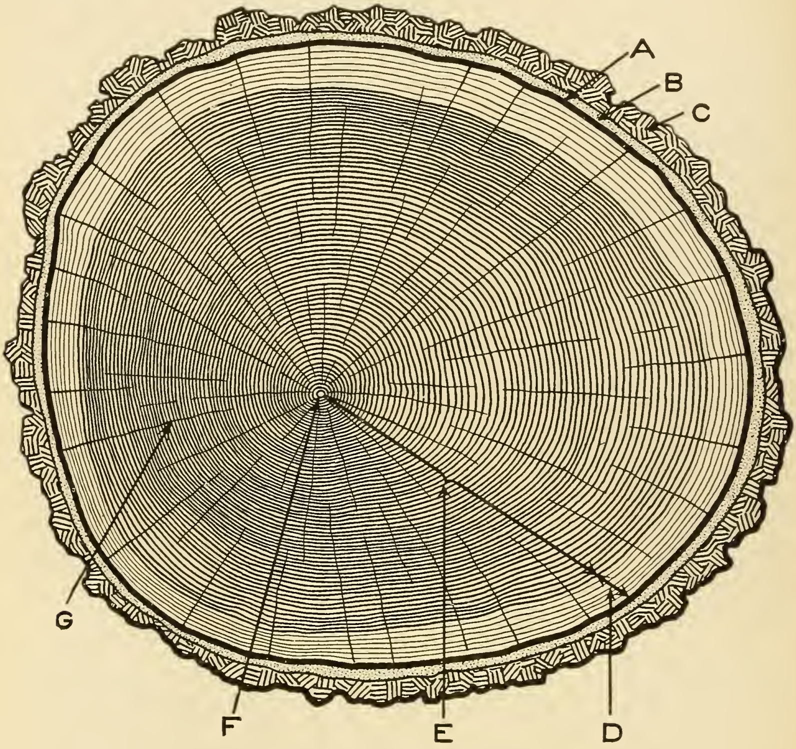

Fig. 7.—How the tree trunk grows. All growth takes place in the cambium, lying between the inner bark and sapwood. This is a very thin layer of living cells which divide and subdivide, forming on the outside bark and on the inside wood (A). The inner bark, or last tissue, is soft and moist. Its function is to carry the food prepared in the leaves to all growing parts of the tree (B). By a gradual change the inner bark passes into outer bark, a corky layer composed of dry, dead cells. This serves to protect the living stem against evaporation and mechanical injury (C). The woody growth during one season is called an annual ring. In the spring the newly formed cells are thin-walled and spongy, while in midsummer and fall the walls of the cells become thicker and denser. This difference can be distinguished in many kinds of trees as light-colored spring wood and darker-colored summer wood. Sapwood (D) is the lighter-colored band of wood beneath the bark, often from 1 to 2 inches thick. It carries the sap from the roots to the leaves. Heartwood (E) is formed by a gradual change in the sapwood by which it becomes darker, heavier, and often more lasting. Most of the trees, but not all, form heartwood. Pith is the soft tissue on the innermost part of the stem, about which the first woody growth takes place in the newly formed twig (F). From it extend the pith rays (G). These are flat, vertical bands of tissue which connect the pith with the various layers of wood and the inner bark. They transfer and store up food

Remove the bark from a green twig and notice the green, moist layer just inside the inner bark. This is what builds the tree. Examine the branch of a box elder or maple. See if your pupils can distinguish last year's growth from that of the preceding year.

Make a mark on a rapidly growing young seedling at a certain height from the ground and have the pupils watch to see if the seedling lifts this mark higher in growing. Count the years of a pine sapling by the whorls of branches it bears.

Study the manner of growing of such trees as maple, box elder, willow, conifers.

Suggestions for supplementary readings:

Trees and How They Grow.—Nuttall.

How Quercus Alba Went to Explore the Underworld.—Andrews. (The Stories Mother Nature Told Her Children.)

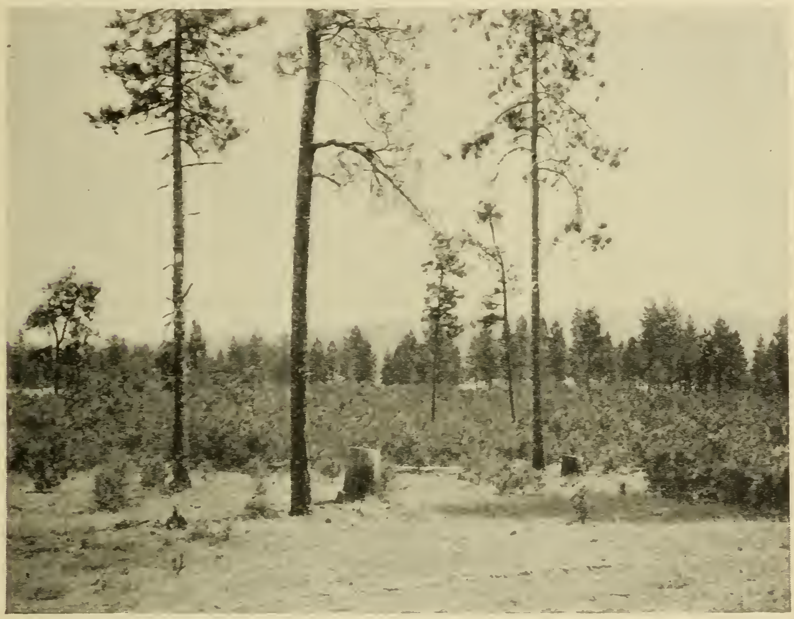
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FIG. 8.—Tree babies around the mothers

PLANT TREES ON ARBOR DAY

Tree Planting and Arbor Day.—The Arbor Day tree is not only a thing of beauty and utility in itself, it is also a symbol, standing for the recognition of the importance of the forest in the life of the Nation.

The following species are among the many that are desirable for planting experiments: Elm, silver maple, locust, catalpa, pine, spruce, willow, and cottonwood.

Have the more advanced pupils prepare a map of the school grounds and make a planting plan to show where trees should be planted to give the best effect.

Suggestions for supplementary readings:

Among Green Trees.—Julia Ellen Rogers.

What Do We Plant When We Plant a Tree?—Henry Abbey. (Days and Deeds.)

OUTLINES FOR INTERMEDIATE GRADES

FIFTH YEAR—FALL TERM

Topic for Study.—Junior forests.

Illustrative Material.—Photograph of tree babies around the mothers (fig. 8). Various kinds of tree seeds.

Subject Matter.—There is little lost motion in nature's plans. Just at the time when the tree stops growing in height it begins to bear seed most abundantly. The seeds are spread over the ground in many ways. Some seeds, like those of the poplar, birches, and pines, are winged, so that they are blown by the wind and scattered far and wide; some, like those of the oaks and hickories, are heavy and fall near by, unless they strike a limb or stone in falling and bounce away from the parent tree or are carried away by birds or squirrels, or by streams. Some species, especially the broad-leaved species and the California redwood, send up sprouts from the stumps of trees that are cut down. In this way, as the old trees fall or are cut out young ones take their places.

The forest soil is fertilized every year by the decay of fallen leaves, and moisture is stored away in it as in a sponge. Thus young trees springing up in the forest have a good chance of being well nourished.

Study Questions.—Watch the wild cherry and juniper trees to see if the birds eat the fruit. Do they carry any of it away?

Can you find seedlings thus planted by birds along fence rows?

Watch a squirrel hiding nuts in the earth. Do you suppose he always comes back to get the nuts he has buried? What may happen if he does not?

If you drop acorns and nuts into a stream, do they float? Are they carried away on the surface of the water or rolled along the bottom?

How does the witch-hazel disperse its seeds?

When the sycamore balls, which give the name "buttonball" to the tree, break up in winter are the seeds carried away by the wind or water, or both?

Why do not all seeds that fall from the trees grow?

Have you ever seen stumps from which sprouts are growing?

If you plant newly fallen seeds of elm or maple, for example, will they sprout at once or lie in the ground one season?

How long after the planting of the seed does the little tree appear?

How many leaves are there at first on the seedling?

Do these look like the leaves of the big tree?

What becomes of these first leaves?

Are there trees in the school yard or around your home?

If so, how did they get there?

Who attended the school or lived in the house when these trees were small?

Practical Exercises.—Collect specimens of various kinds of tree seeds and see if you can find out how they are scattered naturally.

Examine winged seeds of box elder and maple. Throw some of these seeds into the air in a strong wind and see how far they are carried. Now remove the " wings " from some of the seeds and throw them up. Compare the distance these are blown with the distance the winged seeds are carried.

Correlations.—Language: Make lists of trees whose seeds you think are scattered (1) by wind, (2) by water, and (3) by birds or animals. Discuss the importance of leaving seed trees on lumbered land.

Make a fall calendar of tree happenings in the neighborhood.

Learn the following quotation from a poem by William Cullen Bryant:

> Under the rough rind
> In the green veins of these fair growths of earth,
> There dwells a nature that receives delight
> From all the gentle processes of life,
> And shrinks from loss of being.

Geography: Watch for seedlings of the different kinds of trees. Are they always around the mother tree? If not, how did they get to the place where they have sprouted? What seeds are carried by animals? Is there a stream near by that might have borne the seeds along? Are high winds prevalent?

If there were no tree seeds, would the forest disappear? Try to imagine what the wooded places in your neighborhood would be like if the tree families died out; the effect that the disappearance of tree growth would have on the soil, on the climate, on the industries of the region.

Watch lumbering operations in your neighborhood to see whether the lumbermen are careful with young growth. What difference does this make to your home and town?

History: Learn something about the history of Arbor Day and talk about its importance to the Nation. Discuss the forests of the United States, their use and abuse, and the necessity of tree planting.

Suggestions for supplementary readings:

Handbook of Nature Study for Teachers and Parents.—Comstock.
Quercus.—Kellerhouse. (Forest Fancies.)

FIFTH YEAR—WINTER TERM

Topic for Study.—Wood and its uses.

Illustrative Material.—Cross sections of a tree trunk or branch of oak or chestnut, as large as possible, in which the heartwood, sapwood, bark, and annual rings are clearly defined.

Subject Matter.—Wood is easily worked with tools and is held securely by nails and glue. Strength and lightness fit it for many different uses, attractive color and grain for others, durability for others. It is used for houses to live in, boxes and cars to ship goods in, ties for the railroad, wharves for the steamships, mine props for the coal mine. Wherever we go and whatever we do we find ourselves using wood.

Study Questions.—Do you know of a tree that branches close to the ground?

Do you know of one whose trunk grows up tall and clean before branching?

Which would produce the best posts, poles, or lumber?

Count the annual rings on a cross section. How old was the tree?

Can you point out, from the annual rings, any years when the tree did not grow well?

Measure the diameter of the cross section of the log. How many years did the tree take in growing to that size?

Find in the woods a tree whose lower branches are dead. Did they leave scars on the trunk when they fell away?

If boards were cut from the trunk of this tree, would these scars show? How?

What household articles are made from wood?

From what are corks made?

Why is the wasp called "the original paper maker"?

Practical Exercises.—Split or saw an oak stick lengthwise; smooth and polish the surface with sandpaper. Notice the "flaked" appearance of the surface. This "silver grain" is caused by pith rays.

Make collections of wood specimens. Notice whether all the specimens show different colors in sapwood and heartwood. Do any of the woods have noticeable odors?

The woods of the following trees, if available, will furnish interesting material for study and comparison: Fir, cedar, white pine, yellow pine, ash, oak, maple, basswood, spruce, cypress, yellow poplar (tulip tree), and locust.

Correlations.—Language: Read or tell some story about trees. Learn all you can about trees or forests famous in literature and history. Play a game like an old-fashioned spelling bee, naming uses of woods and trees in turn, the player ready with the longest list of forest products or forest benefits being the winner because he or she can outname the others. Find the dictionary meanings of "lumber" and "timber."

Geography: Visit lumber yards, sawmills, planing mills, paper mills, turpentine stills, etc. Study particularly the life of the lumberman and the uses of lumber. Follow the life of a tree from its growth in the woods to its manufacture and use.

Suggestions for supplementary reading:

Wood.—Roth. (In Part III, First Book of Forestry.)
Forest Leaves.—Kellerhouse. (Forest Fancies.)
God's Wonder World.—Cobb.

FIFTH YEAR—SPRING TERM

Topic for Study.—Forests and waters.
Illustrative Material.—Figure 9.

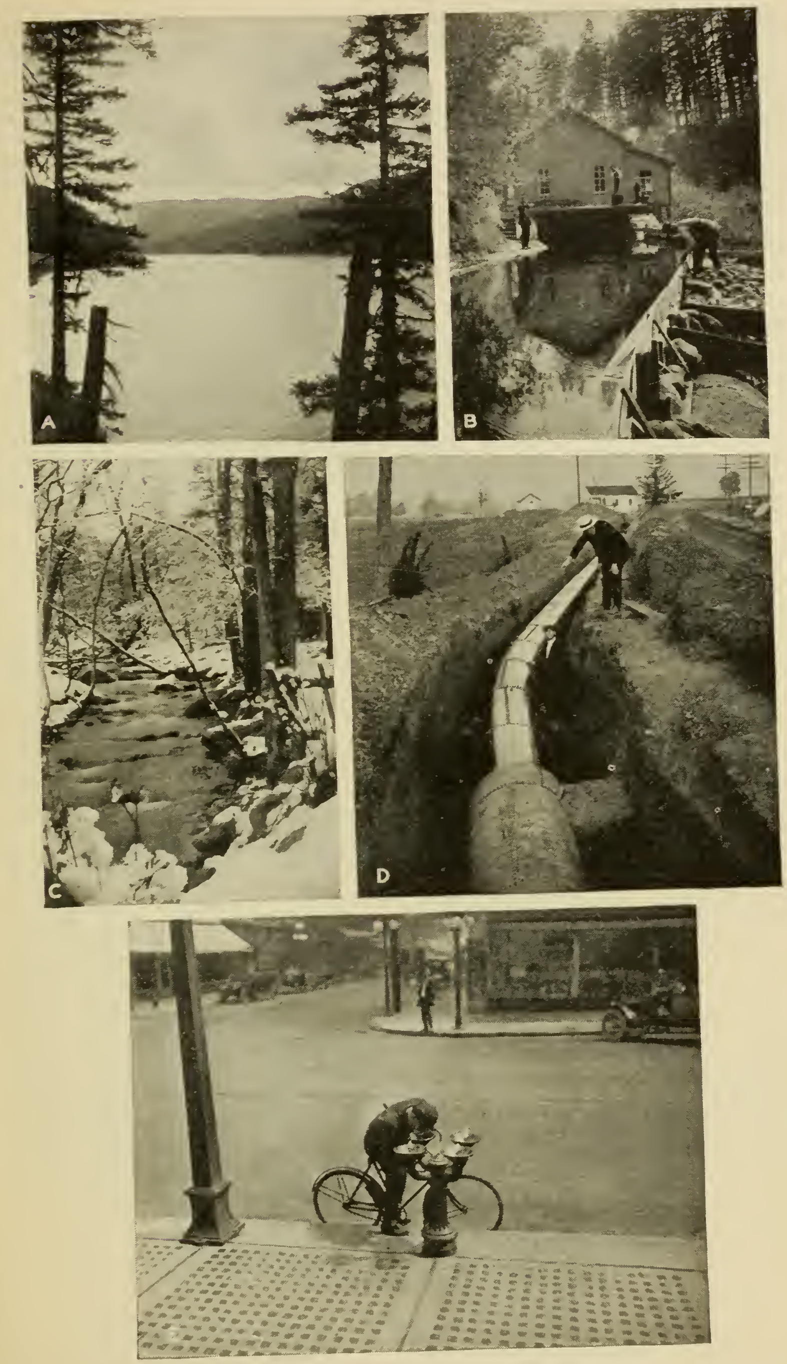

FIG. 9.—The tree is the mother of the fountain

Subject Matter.—Trunks and roots of trees naturally help to prevent the wearing of soil (erosion). The roots at once hold and harrow; no plow serves better to keep the soil soft and friable. A forested watershed therefore acts like a huge sponge in holding moisture and serving it out gradually. Thus forests tend to lessen the violence of floods and to regulate the flow of streams. Where the forest is removed there is erosion of the treeless slopes, washing away of the fertile soil from the sides of the deforested hills, and deposit of silt and sand in the stream channels. The forest cover insures a pure and abundant water supply for domestic uses. The modern sanitary drinking fountain may be a distant relative only of the "old oaken bucket" and of the gourd at the spring; but the source of the refreshing drink is the same—the cool, shady depths of some mountain forest, where the rain or snow water which was held by the sponge of humus and led by the roots of the trees to a hiding place in the crevices of clay or rock bubbles to the surface again in guarded springs.

Study Questions.—When the snow begins to melt in the early spring, does it disappear more rapidly in the woods or in the open fields? What do you think causes the difference?

After a rain, do the raindrops cling to the leaves of the trees or drip off them rapidly?

Does the rain beat as hard upon the ground beneath trees as on roads or open fields?

From which does the rain water run off more rapidly, an open field or ground covered with forest?

What effect, then, would forests have upon water supply? Upon floods?

On a tree recently uprooted by the wind, are the roots totally bare or are they more or less loaded with soil?

Why does the soil cling so firmly to the roots of trees?

How do trees help to prevent washing and wearing away of soil (erosion)?

Where is the air purer, in the forest or in a large city? Can you give one reason for your answer?

Practical Exercises.—Study the forest floor for traces of decayed leaves in the soil. Compare this top soil with that deeper down and note the difference in color. Bring to the classroom small quantities of soil from the woods and from the open road for comparison.

Make a mound of earth in a tin pan. Pour water from a small watering pot over this and notice how it muddies. Remold the mound of soil and cover with blotting paper, with a piece of soft cloth, or with sphagnum moss, then pour on water again. Notice how clear the runoff is, and how little disturbance there is to the mound beneath the covering. Carry the idea to the influence of forest cover on hillsides. (See experiment 12, p. 54.)

Correlations.—Language: Learn and discuss the following quotation:

> The forest leaves
> Convert to life the viewless air (fig. 10).

Geography: Discuss the importance of trees to the farmer, as in preventing soil erosion, and in regulating water supply.

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FIG. 10.—"The forest leaves convert to life the viewless air"

Suggestions for supplementary readings:

The Forest as a Protective Cover.—Roth. (First Book of Forestry.)
Relations of Trees to Water.—Flagg. (Arbor Day.)
The Land of the Poor People.—Fairbanks. (Conservation Reader.)

SIXTH YEAR—FALL TERM

Topic for Study.—Enemies of the forest.

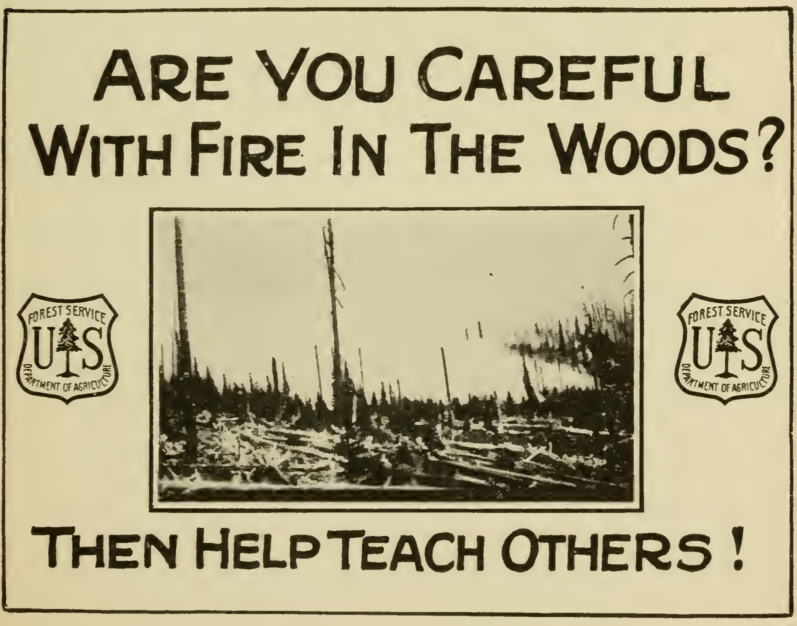

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FIG. 11.—Fire slogan

Illustrative Material.—Figure 11.

Subject Matter.—"The forest is threatened by many enemies," to quote again from A Primer of Forestry, Part I, "of which fire and reckless lumbering are the worst. In the United States sheep grazing and wind come next. Cattle and horses do much less damage than sheep, and snowbreak is less costly than windfall. Landslides, floods, insects, and fungi are sometimes very harmful. The forest is attacked in many other ways. For example, birds and squirrels often prevent young growth by devouring great quantities of nuts and other seeds, and porcupines and mice frequently kill young trees by gnawing away their bark."

Study Questions.—Look for trees in the forest that have begun to decay. Can you find any break or wound in the bark where decay started?

Now find some tree from which a branch has been smoothly cut close to the trunk. Is this wound healing? How is it being covered?

When we gather holly for Christmas decorations, how should we cut the sprigs, and why?

Do you know of any hollow tree in your neighborhood?

When the heart of a tree decays does the tree die?

Will it resist the wind as one whose heartwood is sound?

Do you think a tree could live without any heartwood?

Why is a parasite, mistletoe, for instance, an enemy of a tree on which it lives?

Do the limbs of trees on which caterpillar webs appear seem to be injured?

What birds destroy insect pests on trees?

What can we do to protect these birds?

After the leaves have fallen from the trees is there danger of fire?

Is there more danger of fire in a pine forest than in hardwoods?

How do the United States Government and State governments provide for preventing and fighting forest fires?

What are the duties of forest rangers?

Practical Exercises.—Notice how pine trees try to cover wounds by pouring resin over them. Look for globules of gum over broken places in the bark of black cherry, spruce, or balsam fir.

Look for punks on trunks of trees that are beginning to decay. Watch to see which trees in your neighborhood are attacked by insects. Look for caterpillar webs on trees. Watch for the beetles that feed upon the leaves and bore into the bark and wood of certain trees.

If the white-pine blister rust or other disease has attacked the trees in your part of the country, try to find out what your State, the Federal Government, or tree lovers are doing about it.

In the dry season watch the newspapers for accounts of forest fires. Study how these fires originate, how they are fought, and the damage they do.

Correlations.—Language: Write or tell a story around the following quotation:

> One tree will make a million matches;
> One match will burn a million trees.

Geography: Study the seasons at which woods fires are most apt to occur in your State. Are such seasons dry? At what seasons is rainfall sufficient to prevent fires? What industries in your vicinity are affected by forest fires?

What birds and animals in your locality feed upon insects that injure the trees?

Suggestions for supplementary readings:

Woodman, Spare That Tree.—George P. Morris. (Trees in Poetry and Prose. Arbor Day.)

The Happy Little Birch Tree.—Selected. (Stories from Garden and Field. Vol. V.)

Forest Trees.—Washington Irving. (Trees in Poetry and Prose.)

SIXTH YEAR—WINTER TERM

Topic for Study.—The service of the forest.

Illustrative Material.—Articles made of wood and other forest products: Chair, table, pencil, ruler, matches, excelsior, sawdust, charcoal, cork, paper, turpentine, maple sugar, nuts, and rubber. (The pupils should amplify this list.) Also a picture of a camp in the woods.

Subject Matter.—Wood is an everyday material, necessary to our comfort, convenience, health, pleasure, and recreation. Whether it be for wood, for shade, for beauty, for tenacious hold of the soil, for protection of springs and streams, for fruit or sap, or for healthful influence on the climate, the forest is the friend of the home maker, the farmer, the manufacturer, the nature lover, the health seeker. Food, shelter, clothing, fuel, recreation, health, art, and industry are forest made in part at least, and religion has since the beginning of time been under the forest's influence.

Study Questions.—What becomes of the fallen leaves?

Of what use are they to the seeds and roots buried in the earth when they cover the ground beneath the trees through the winter?

Of what benefit are they to the soil with which they become gradually mixed?

What industries in your town or county depend upon products or influences of the forest?

From what is most paper made?

What forest product is necessary to the tanning of leather?

How are turpentine, wood alcohol, and charcoal obtained?

How do we get maple sugar?

What articles in your home are made from wood? In your school?

How is most of our food brought to us, if we live in the city? Our clothing? How are shelter, fuel, and water supply dependent upon the forest?

Do you know where the most important forests of the United States are located (fig. 12)?

Are the forests of this country as extensive as they were when the first explorers and settlers came?

Are they growing as fast as they are being cut?

What materials are being used to some extent instead of wood in buildings, sidewalks, bridges, fences, etc.?

How may such materials as railroad ties, fence posts, telephone poles, and mine timbers be made to last longer? Is this worth while?

Practical Exercises.—Make a complete list of all the different trees you have found and identified in your locality. Classify them as conifers (softwoods) or broad-leaved trees (hardwoods). Give the various uses of each tree identified.

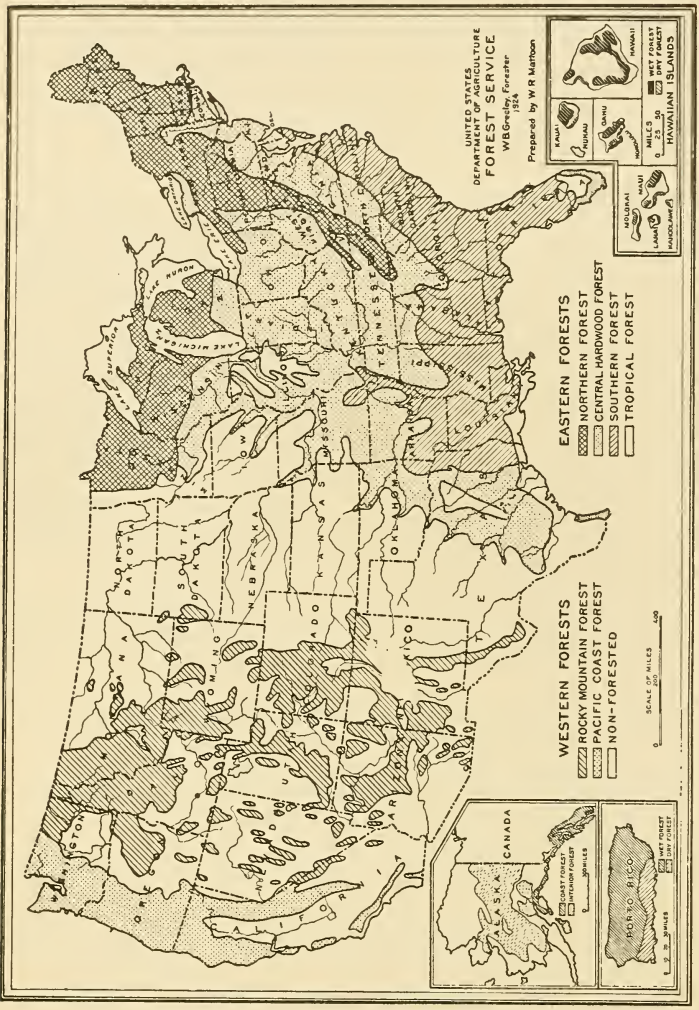


FIG. 12.—Forest regions of our country

The United States contains 470 million acres of forest land of all sorts—timbered, cut over, and burned—all of which is more suitable for growing trees than for any other use. Much of this will always be forest land, and the area is ample to grow all the wood needed for our own use and for export trade, *if it can be kept at work growing trees.* However, 81 million acres of this forest land is now lying idle, a waste caused in large part by careless cutting and destructive forest fires.

Collect samples of various products, such as wood pulp, tanbark, maple sugar, and crude turpentine. (See also Collection of commercial products of the forest, p. 63.)

Correlations.—Language: Talk about the usefulness of the trees for shade, and their beauty. Tell about the home building of birds and squirrels in the tree tops, and how the leaves, branches, and roots of the trees afford hiding places and homes for many creatures that live in the forest. Then try to think of some ways in which these tiny tenants repay the trees.

Geography: Study on a map of the forest regions of the United States the location of the chief coniferous forests; of the important broadleaf or hardwood forests. Show these by colors drawn on a map, on the blackboard, or on paper.

Suggestions for supplementary readings:

Salute to the Trees.—Henry Van Dyke.
Trees and Forestry.—Dickerson.
The Little Foresters.—Hawkes.

SIXTH YEAR—SPRING TERM

Topic for Study.—The friends of trees and forests.

Illustrative Material.—Stories or pictures of John Muir, John Burroughs, Anna B. Comstock, Theodore Roosevelt. The story of the tree that owns itself, at Athens, Ga. The story of the saving of the Cameron elm in front of the United States Capitol, Washington, D. C. The legend of the origin of Raphael's Madonna of the Chair. Anecdotes of the robin, the woodpecker. and other insect-eating birds. Something about anyone in your neighborhood who loves and cares for trees. Arbor Day exercises.

Subject Matter—

A people without children would face a hopeless future; a country without trees is almost as helpless; forests which are so used that they can not renew themselves will soon vanish, and with them all their benefits. A true forest is not merely a storehouse full of wood, but, as it were, a factory of wood, and at the same time a reservoir of water. When you help to preserve our forests or plant new ones you are acting the part of good citizens. (Theodore Roosevelt, in a Letter to the School Children of the United States.)

Study Questions.—Have you ever visited woods where "fallers" and loggers were at work?

Were the stumps cut low or high?

Was any good wood wasted?

What was done with the tops of trees that were cut?

Was there any young growth or "junior forest"?

Do the farmers of your neighborhood make a practice of allowing cattle or sheep to graze in their woodlands?

Do the cattle or sheep browse the leaves of the young growth?

Do they injure the young trees by trampling or rubbing?

What do you think of the plan of using farm woodlands for grazing purposes?

What care is taken of your city street trees?

Are the young trees protected by guards? Why?

Do you find any trees injured by the pavement being laid too closely about them?

What trees do you think are the best for street planting? Why?

In transplanting a tree, why is it important to take up as many roots as possible and to keep the roots from drying?

Which would make a better windbreak, an evergreen or a tree that sheds its leaves in winter?

How do squirrels and birds pay for board and lodging?

What is done in your community to prevent the spread of insect infestation of trees?

How do you protect your woods against fire?

Practical Exercises.—Visit woods where trees are being cut for logs or posts or ties. Look for defective trees; large trees of undesirable species overshadowing smaller ones of better kinds; trees that are full grown, or nearly so, and that may be removed to give more light to younger, growing trees.

Review what has been learned about individual species of trees, and find out all you can about their characteristic features, growth, uses, etc.

Correlations.—Language: Write little stories about things that are going on in the woods every day:

1. Morning in the forest.
2. Bedtime in the forest.
3. Stories the leaves might tell.
4. Things that the roots have learned.
5. How the trees keep well.

Discuss birds as (1) tree planters and (2) guardians of trees against injurious insects.

FIG. 13.—The best friend of the forest

Geography: Notice on which side of the trees mosses grow; the bending of trees on hillsides; trees that love moisture and where they grow best; trees that can stand cold and where they are found. Notice how trees conquer unnatural conditions in soil and light supply, as in the instance described in the following:

> On a steep bank which has suffered a landslide grows a poplar. Once it had a station far up, but its foundations were shaken while yet its roots were shallow, and it fell headlong down the slope. Catching upon a snag, the tree stopped halfway down the wall of the gorge, and a mass of earth accumulated upon its upturned roots. The tree was thus replanted, head downward. Three years it has been growing. Its large branches still point down the bank, but the younger ones have turned and gone the other way. Through the framework of larger branches they have forced their way to liberty and light. (Among Green Trees, by Julia Ellen Roger.)

Suggestions for supplementary readings:

Ten Common Trees.—Stokes.
Trees in Poetry and Prose.—Stone and Fickett.
A Primer of Forestry.—Pinchot.

OUTLINES FOR SEVENTH, EIGHTH, AND NINTH GRADES OR JUNIOR HIGH SCHOOL CLASSES

Forestry is a science too technical to find an individual place in the junior high school curriculum, yet every course in nature study, geography, history, civics, botany, agriculture, general science, the manual arts, and even the fine arts, involves the study of many direct and indirect influences of the forest. Just so medicine and law, although not taught in the elementary schools, have their rudiments introduced through biology, hygiene, physics, general science, and civics. Pupils in the modern schools are thus being prepared to understand the laws governing the world in which they live, a preparation as important as the mastery of the alphabet or the multiplication table.

SEVENTH YEAR—FALL TERM

Topic for Study.—Forests in history and civics.

Illustrative Material.—Historical exhibits in any museum of ways in which products of the forest have been used as fuel; wooden parts of ships, railroads, airplanes, or other means of transportation; utensils and instruments; and aids in home building and furnishing. Material used in industries that have built up your community.

Subject Matter.—Much of the world's civilization and much of its history have been influenced by the forest. The forest has been the source of implements of warfare, of vehicles for transporting the world's goods, of fuel not only for domestic use but for the fires of blacksmith and armorer, and of building material for permanent settlement; in fact, of many of the things upon which nations depend for defense, for peaceful development, and for expansion.

Since the beginning of history the forests have supplied wood for the building of the fleets of nations and for ships of explorers and settlers. The cedars of Lebanon were indispensable to the shipbuilder of ancient Egypt and Phoenicia. It has been said that the man who really laid the foundation of the naval power of England was John Evelyn, because he planted oaks out of which, a century later, England's ships were made.

The first impression of the New World received by the Pilgrim Fathers has been immortalized thus:

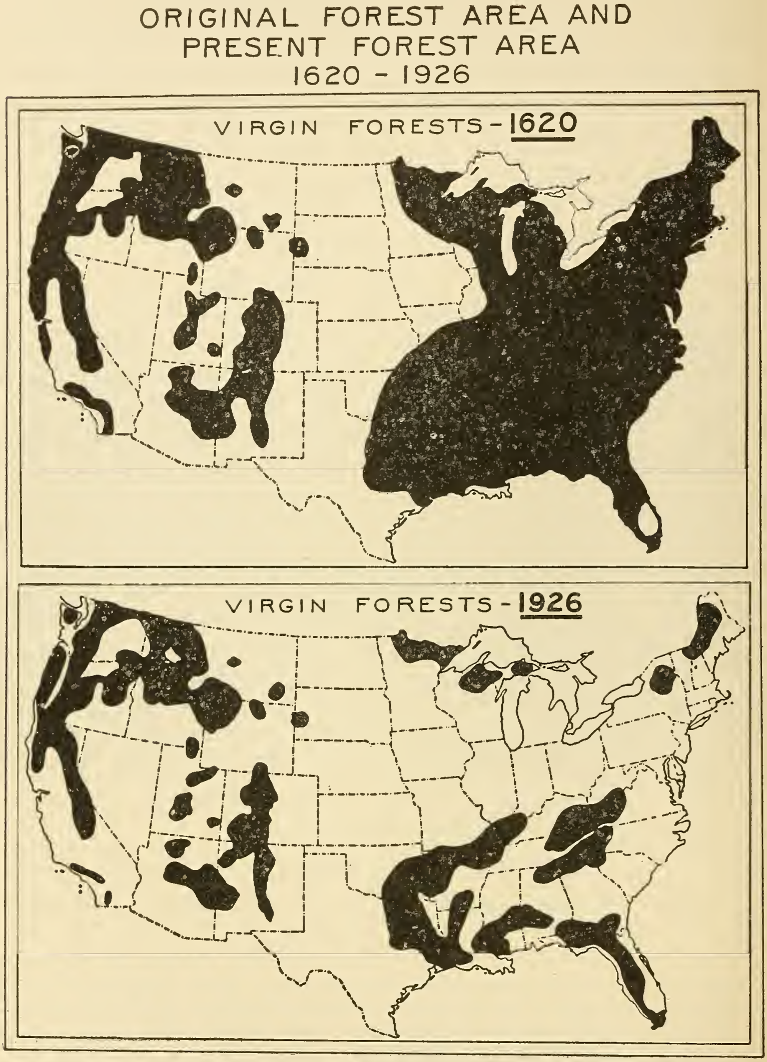
> The breaking waves dashed high
>   On a stern and rockbound coast;
> And the woods against the stormy sky
>   Their giant branches tossed.

As the frontiers of our country have steadily stretched westward, the sawmill has kept pace with the pioneer. New England spruce, birch, hemlock, and pine housed the early settlers and supplied the means for further explorations along the coast. The pine of the lake shores, the mixed hardwoods of the southern Appalachian region, the southern pinery, the conifers of the Rocky Mountain and Pacific coast areas, have contributed in turn to the upbuilding of the separate sections. At the same time our forests have advanced means of communication and done much toward the welding of the States into one great nation.

Study Questions.—What was the extent of our forest regions when the early settlers landed at Plymouth or Jamestown?

What was the importance of the forest to the settler and the pioneer home builder?

What effect did the clearing away of the forest, to make room for crops of food products, have upon the American idea of its value?



ORIGINAL FOREST AREA AND PRESENT FOREST AREA 1620 - 1926

VIRGIN FORESTS - 1620

VIRGIN FORESTS - 1926

FIG. 14.—American forests then and now

What is meant by the expression, "Timber—mine or crop?"

What was the cause of the "hunt-and-hide" attitude of the colonists toward the forest? (Mention both game and Indian.)

What part have forests played in our civic and industrial development, in connection with railroads, shipbuilding, telegraph and telephone, manufactures, agriculture, mines, cities, homes, health, recreation?

Correlations.—Language: Tell a short story of the forest as it might have been told by one of the following personages: King Solomon; Christopher Columbus; Daniel Boone; General Pershing; the King of England.

Geography: Study the map of the national forests (p. 45). Note that most of these forests are located in the mountainous regions. Explain the reason for this. Is there any national forest or part of a national forest in your State? In what region is it located? Is there any other forest in your State that should be protected or any waste forest land that should be replanted?

History: Discuss any event in your current study of history in which the forest or its products may have played a part; for instance, as aids to transportation for explorers; materials for war or the advancement of peace; conveniences for settlers in new regions.

Mention at least three ways in which the forest has contributed to the upbuilding of your community.

Discuss the historical significance of the following statement:

> The temperate regions, the highway of the world's most advanced civilization, form at the same time the habitat of its best timber, the coniferous or softwood supply, which, because of its lightness, strength, and the ease with which it is worked, is unrivaled for construction purposes by the hardwoods.

Discuss the question, what caused the movement of the lumber industry in the United States southward and westward?

Suggestions for supplementary readings:

Conservation Reader.—Fairbanks.
The Land We Live In.—Price.
The Romance of Our Trees.—Wilson.
The Story of the Forest.—Dorrance.

SEVENTH YEAR—WINTER TERM

Topic for Study.—Forests and geography.

Illustrative Material.—Figure 15.

A block of earth matted with fallen leaves, spaded out and set with the least possible disturbance in a box from which one side is then removed to show the layers of earth. Articles illustrating the contributions of the forest to our daily needs: Some product of the lumber industry; of the farm woodland; some article made of wood. Description or illustration of relation between the forest and commerce; the forest and the mine.

Subject Matter.—(1) The forest as a physical force; effect upon soil and water supply. (2) The forest and our daily needs. (3) The forest as a playground. (4) Forests and health. (5) The multitude of by-products of the forest. (6) The forest and industry, lumbering, farms and forests; the forest and the manufacturer, material and power; commerce and the forest, material and effect upon stream flow; mine timbers. (7) The national forests and the public welfare.

Study Questions.—Explain what is meant by the expression "Trees build soil."

If you sink a spade into the forest floor, what will you find entangling and holding the soil?

Most crops impoverish the soil; how do trees, on the other hand, continually enrich it?

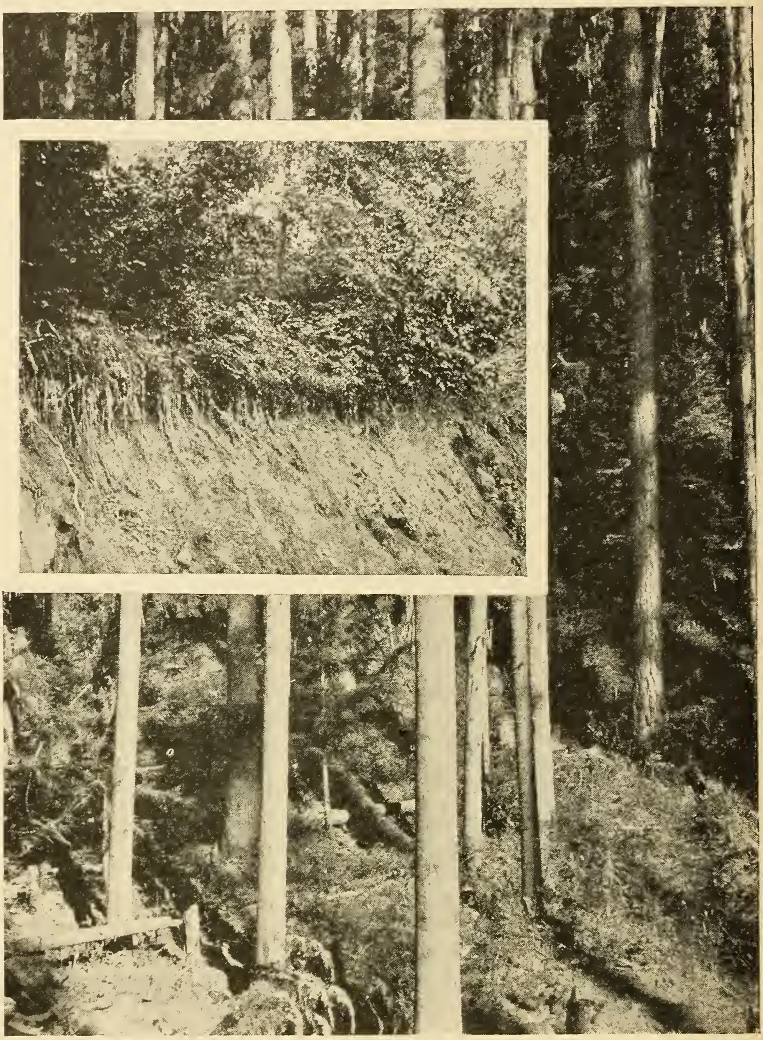


FIG. 15.—The forest as a physical force. Trunks and roots of trees form mechanical obstructions to soil erosion. Thus forests tend to lessen the violence of floods and to regulate the flow of streams

What effect does the litter of fallen leaves and twigs have on the forest floor?

What do we mean by mulch? Find the dictionary meaning and discuss it.

What is humus? Consult the dictionary and then try to find an exhibit.

Do soil and air temperatures within the forest differ from those without? Does humidity?

What is meant by the statement, "The forest leaves convert to life the viewless air"?

What did Plato mean by "the sickening of the country" following deforestation?

Practical Exercises.—Make an exhibit or demonstration of forest products in constant use for food, shelter, fuel, and manufacture of clothing; and of forest influence on water flow.

Give instances of the effect of forests or woodlands near your home on shade, temperature, relative humidity, air currents, water-holding capacity of the soil, evaporation, melting snows.

Correlations.—Language: Read and discuss the following quotations:

> When multiplying man had filled the open grounds along the margin of the rivers, the lakes, and the sea, and sufficiently peopled the natural meadows and the savannas of the interior, where such existed, he could find room for expansion and further growth only by the removal of a portion of the forest that hemmed him in. The destruction of the woods, then, was man's first geographical conquest, his first violation of the harmonies of inanimate nature. (The Earth as Modified by Human Action. Marsh.)

> How foolish do men appear, destroying the forest cover without regard for consequences, for thereby they rob themselves of both wood and water. (Humboldt.)

Geography: In industrial geography, what importance is placed on lumbering? Build an imaginary home, and tell where the forest products used come from. Make a home-building map showing points from which these materials come and the route by which they are brought.

General science: Some twigs kept in water in the schoolroom or at home may be made to swell their buds, stirring with life before the call of spring. The next marvel will be the putting out of leaf and blossom. Becoming familiar with them constitutes another step in learning to know the trees. With this preparation, there is probably not a child in school who will not be interested in every tree in sight between the school and home, and who will not form the habit of exploring with sharp eyes the roadside growth of bushes, noticing and comparing buds and sprays and stems. Very likely there will be many pleasant surprises when the bursting leaves bring recognition of some old friends that have been masked in strangeness during the long season of bare boughs.

Suggestions for supplementary readings:

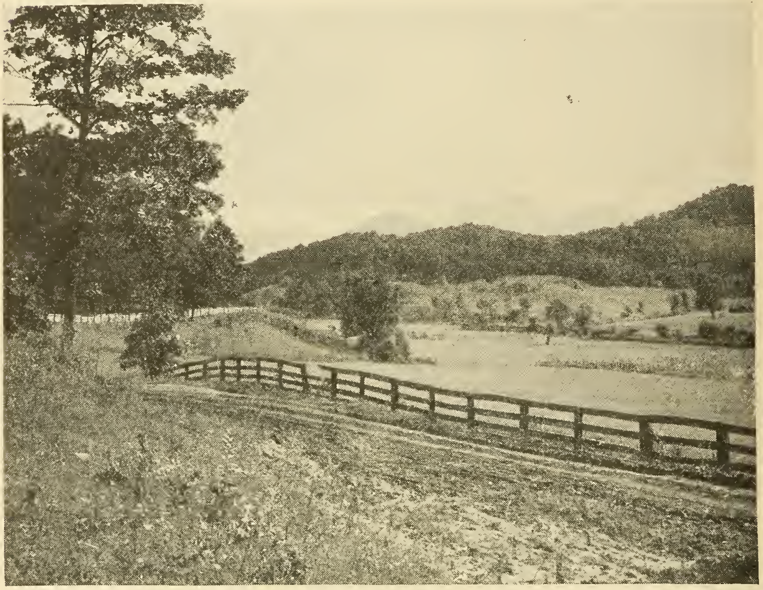
Industrial and Commercial Geography.—J. Russell Smith. New edition, September, 1925.
Salute to the Trees.—Van Dyke.
The Forest Hymn.—Bryant.
Conservation of Water.—Mathews.

SEVENTH YEAR—SPRING TERM

Topic for Study.—Forests and industry.

Illustrative Material.—A diagram showing how the forest contributes to various industries. For instance:

- Manufactures:
  - Power.
  - Materials.
  - Lumber and other wood products.
- Mining:
  - Mine timbers.
  - Charcoal for smelting.
- Agriculture:
  - Soil protection.
  - Stream-flow regulation.
  - Windbreaks.
  - Irrigation.
  - Farm building materials.
  - Farm implements.
- Commerce:
  - Shipbuilding materials.
  - Railroad ties.
  - Telegraph and telephone poles.
  - Boxes and barrels.



F-25435

FIG. 16.—The forest is the farmer's friend at home

"At the head of all the sciences and arts, at the head of civilization and progress, stands—not militarism, the science that kills, not commerce, the science that accumulates wealth, but agriculture, the mother of all industry and the maintenance of human life."—Garfield.

Subject Matter.—Lumbering: Lumbering ranks among the major industries of this country. The United States produces more than half of the world's supply of wood and uses 95 per cent of what it produces.

To agriculture the forest is an indispensable ally in enriching and protecting the soil; in regulating water supply; in moderating winds; and in providing materials for farm buildings, fence posts, and other essentials (fig. 16), and winter employment for farm labor. On most farms woodlands are maintained for the production of farm timbers. Farms in arid regions owe much to the forest for its protection of sources of irrigation (fig. 17).

The manufacturing industry is largely dependent upon wood for lumber, pulp (for paper), naval stores, dyes, etc. The wood-using plants of all classes now consume annually 24,500,000,000 feet of wood. Again, the forest has an indirect but important influence upon the industrial world in the protection of water-power resources. The water power of the 11 Western States, which has contributed to the upbuilding of that great region, is insured for perpetual use by the national forests within which the headwaters of the streams lie.

The forested watershed is the guardian of our navigable streams. The purchase of lands in the East for national forest administration is authorized by Congress for the "protection of the headwaters of navigable streams." Many necessities of transportation are products of the forest also. Railroad ties, telephone poles, bridge timbers, vehicle stock, airplane stock, cooperage stock, piling, and fuel are supplied by the forest. More wood is used in constructing railway cars than before the steel car was developed. In spite of steel ships, no entirely satisfactory substitute for wood has been found for certain indispensable ship parts.

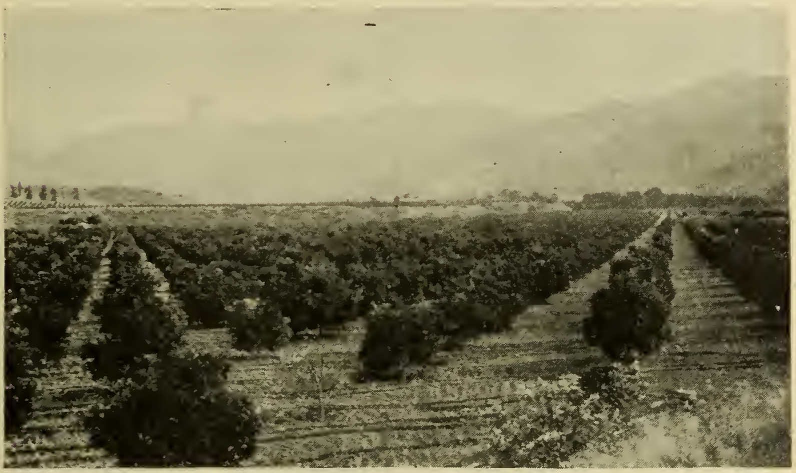


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FIG. 17.—The farmer's long-distance friend

Orange grove near Corona, Calif., dependent upon irrigation from the watersheds protected by the Cleveland National Forest.

From the mine in the depths of the earth comes to the forest, which is busy overhead, the demand for mine timbers. In the smelting of the rivals of wood—iron, tin, copper—low-grade forest material which might otherwise be wasted is utilized in the form of charcoal. Other industries too numerous to discuss call for help from the forest.

Study Questions.—Cut off a small branch of maple or box elder. What is the watery fluid that flows from the wound?

How does the forest cover act as a great sponge?

Why does famine follow the erosion of lands, as for instance, in China (fig. 18)?

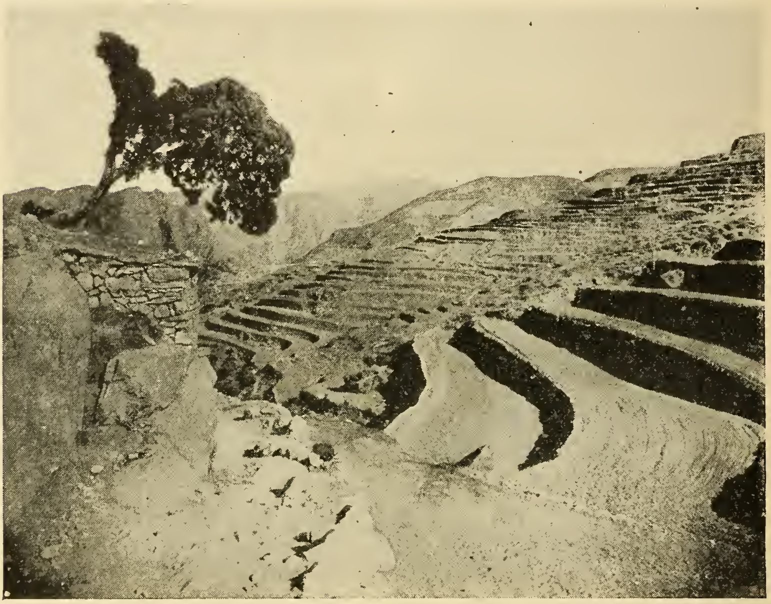
What has the forest to do with the fact that flood and famine are almost unknown in Scandinavia, Germany, France, and Switzerland?

What is the relation of forests to reclamation of desert land for agricultural use?

What is a windbreak? Where and why is it used (fig. 19)?

What is the relation of the forest to the needs of man for shelter, fuel, water, food, clothing, medicine, paper, and other necessities?

Practical Exercises.—Make a list of the leading business occupations of your community. Study the industries which they represent. What relations has the forest to these industries?



F-47896

FIG. 18.—Land that is sick and poor

Centuries ago China was heavily forested. Now all of the northern portion is practically treeless; the lands are eroded, the valleys suffer from severe and frequent floods, and famine and pestilence are common.

If possible visit a factory, a farm, a mine, and a store, keeping your eyes open for products of the forest and ways in which the forest has helped to build up the industry.

Correlations.—Language: Read the following quotations and write your own story of what you think they mean:

> The legend of Erichthonios most beautifully hints at the dependence of agriculture on forest cover; when by the felling of a holy oak he has offended the dryads, Ceres, the patroness of agriculture, is asked to send one of their number to the mountains to fetch Famine, who takes hold of Erichthonios and kills him. (Economics of Forestry. B. E. Fernow.)
>
> Man can not get along without wood. It has been useful in all stages of civilization, and the more civilization advances the greater is the number of services it

renders us. It serves as fuel for the savage's camp fire. It makes the wagon in which the roving tribesman carries his family and goods, and when he settles down to agriculture he uses wood for his plow, for his house, for the barns for his cattle. and for the fences that limit his land and keep his cattle from wandering away. It rendered the same services in the making of house, barn, fence, and household fuel throughout colonial America, and to-day its use even as fuel is as great in the United States as ever before. World commerce is served by the millions of trees that go each year into the bed of the railway as ties, while the lordly conifer has for centuries been the mast of the ship.

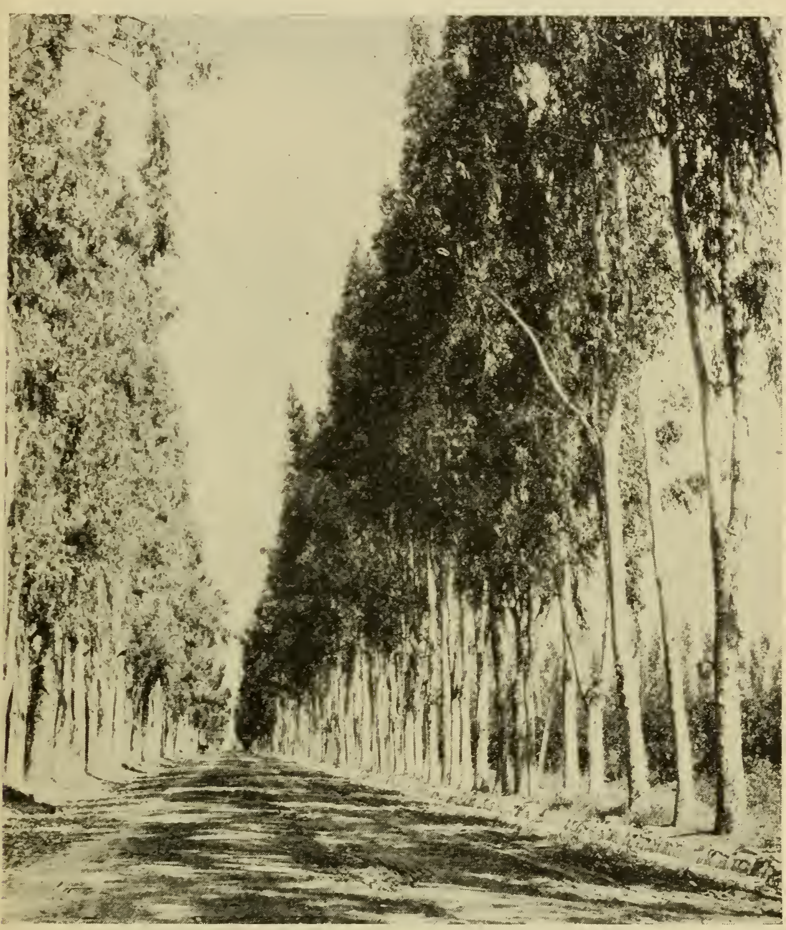

F-63432

FIG. 19.—Vista through stately blue gums protecting orange orchards.

In this day of great movements of goods surprising quantities of wood are used for barrels and packing boxes, a single Philadelphia soap factory using for this purpose five carloads per week. Each day some inventor finds a substitute for wood in one of its uses, but other inventors find corresponding new uses for it, so that our dependence upon it is increasing day by day. It has even become essential to the spreading of knowledge, for practically all our books and magazines are printed on paper made of wood pulp. (J. Russell Smith. Industrial Geography.)

Geography: How have the topography and soil conditions in your neighborhood made it a suitable environment for the different kinds of trees that grow there?

Consider the forest as a crop; the woodland as a source of supply; caring for the woodland, protection from forest fires, over grazing, trespass; thinning; reproduction; harvesting the crop; planting.

Suggestions for supplementary readings:

Practical Nature Study and Elementary Agriculture.—Coulter, Coulter, and Patterson.
Elements of Agriculture for Public Schools.—Harrington.
Nature Studies on the Farm.—Keffer.

EIGHTH YEAR—FALL TERM

Topic for Study.—Wood for the Nation; other forest products.

We are prone to call this the age of steel and electricity and to look upon wood as the foundation of an earlier and more primitive civilization. Yet, when one considers the part which wood plays in modern life, housing, transportation, manufacture, and particularly the dissemination of knowledge by means of books and newspapers, this is truly an Age of Wood. (Gifford Pinchot, in foreword to Forest Resources of the World, by Raphael Zon and William N. Sparhawk.)

Illustrative Material.—Figure 20.

Subject Matter.—Important facts concerning the use and abuse of forests and their products:

"America is the richest of all continents in useful woods," says J. Russell Smith, an authority on commercial and industrial geography: But—

Four-fifths of the virgin forest area of this country has been cut or burned.

We are now using wood four times as fast as we are growing trees.

Fifty per cent of the timber now standing is in the three States bordering the Pacific coast.

Our railway systems require about a hundred million crossties every year.

To market the citrus crop of Florida for one year requires over 15,000,000 boxes, each box taking 5½ board feet of wood. At the present rate of increase in this demand upon southern forests for lumber many more million boxes will be required for this use by the end of the decade.

We burn matches at the rate of 7 a day per person. Over 4,000,000,000 boxes of matches, estimated to be equivalent to 250,000,000,000 matches, are manufactured in the United States each year. A recently developed machine, consisting of a veneer lathe, a splint machine, and a dipping machine, will produce direct from the log nearly 2,000,000 matches a day. White pine is the chief wood used for matches, and most of it comes from the Northeast.

IF WE ARE TO REMAIN A NATION OF WOOD USERS, WE MUST BECOME A NATION OF WOOD GROWERS.

Study Questions.—Have you ever visited a sawmill or a lumber yard?

Sawdust and mill ends were formerly destroyed by burning. What uses has sawdust to-day that make it a valuable forest product?

From what is wood alcohol made?

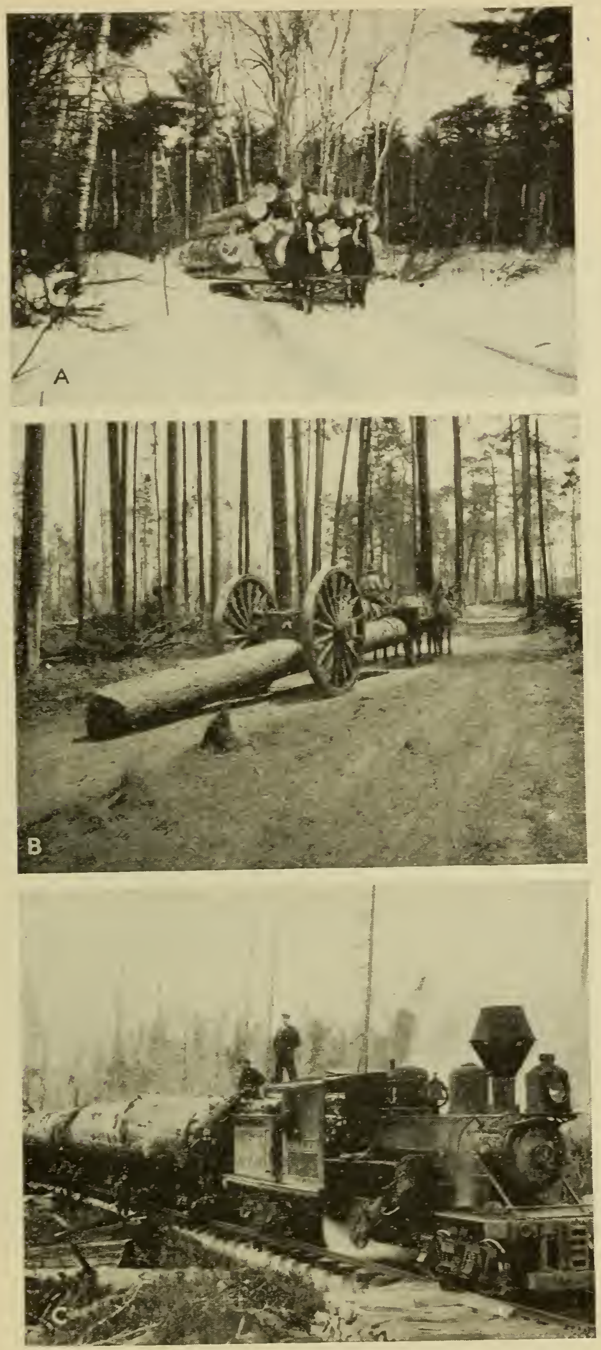
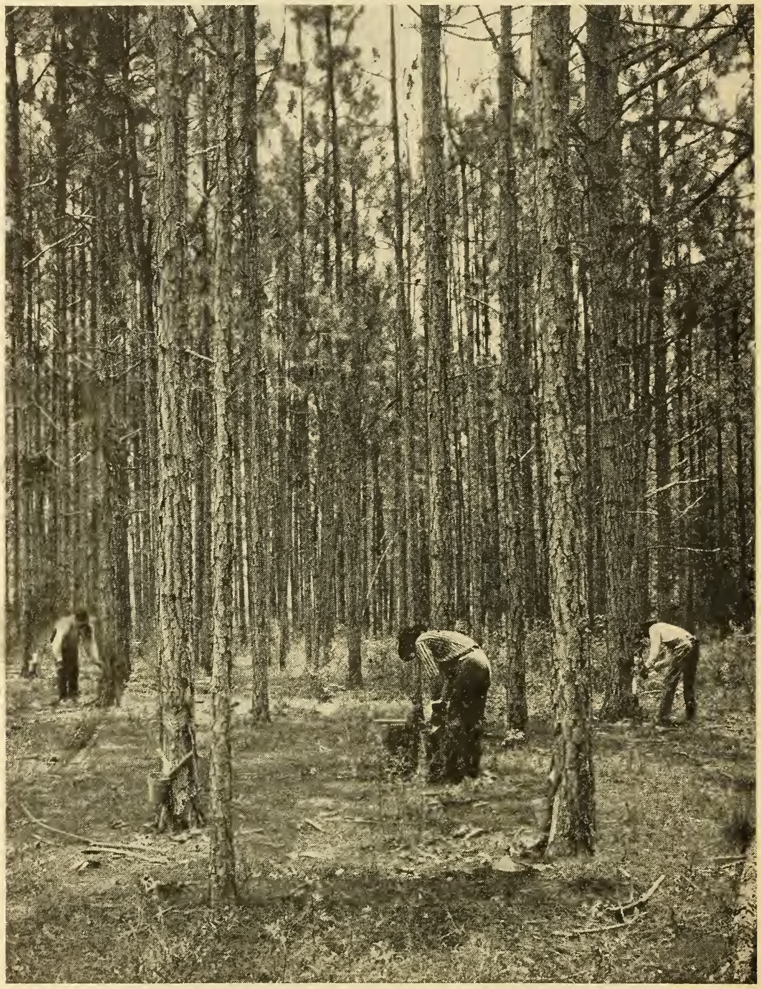


Fig. 20.—Log transportation. A, the logging sled of the north. B, the big wheel of the south. C, the logging train of the west

Which tree furnishes the greatest amount of lumber in the East? In the West?

What eastern species furnish both lumber and sap of great usefulness? (Fig. 21.)

Practical Exercises.—Discuss in detail the manufacture and uses of one or more of the following articles: Furniture, vehicle stock, handles, woodenware, veneer, railroad ties, mine props, staves, shingles, lath, poles, piles, excelsior, fuel wood, tanbark, etc.



F-40139

FIG. 21.—The tree of many uses

Long-leaf pine is a tree of first importance as the source of useful and valuable products. The long, straight trunks are in great demand in shipbuilding and for other construction purposes. The strong, durable, straight-grained timber sawed into boards takes the lead in our lumber supply. The resin yields spirits of turpentine and other products, valued at many million dollars annually. The leaves furnish by distillation an oil, and by treatment with alkali, a "pine wool" that is utilized for various purposes. It may well be said of this tree that we use "all but the knotholes."

Discuss forest products other than lumber, such as gums, resins, turpentine, rubber, dyestuffs, quinine, artificial silk, cork, vanilla, tannin, maple sugar, nuts, etc.

If possible, bring in samples of forest products.

Correlations.—Language: Write the story of a match; of a lead pencil; of a golf club.

Learn the following stanza from Henry Van Dyke's poem, "Salute to the Trees":

Many a tree is found in the wood
And every tree for its use is good:
Some for the strength of the gnarled root,
Some for the sweetness of flower and fruit;
Some for a shelter against the storm,
And some to keep the hearthstone warm;
Some for the roof, and some for the beam,
And some for a boat to breast the stream;
In the wealth of the wood since the world began
The trees have offered their gifts to man.

Geography:

> The difference between this country and the countries of continental Europe in the use of wood is not the difference between a young nation and old nations; it is the difference between a country with high standards of living and rapid industrial growth and countries of low standards of living and industrial conditions largely fixed and unchanging. Picture an average rural section in France, where a new structure of any kind is a rare sight, and mean, moss-covered buildings of the time of Jeanne d'Arc must serve the needs of the French farmer of to-day. With all its beauty and picturesqueness, you carry away an impression of economic decadence, of low standards of living, and inefficient methods of farming, under which life is possible only by frugality and restrictions on comfort unknown to the masses of the American people. Compare this picture with the average rural section in New York or Minnesota or Iowa and you will understand the difference between a country where wood has been plentiful and a country where wood is classed almost with the luxuries. (Wood for the Nation, Separate No. 835, Yearbook of the United States Department of Agriculture, 1920.)

On an outline map of the United States, put in one color and in the proper locations the names of places from which forest products used in the home are brought to your town, and in other colors the names of places from which come forest products used in the industries of your county or State.

Suggestions for supplementary readings:

Forest Products: Their Manufacture and Use.—Brown.
Our Trees and How They Serve Us.—Maddox and Parkins.
Timber (A Novel).—Titus.

EIGHTH YEAR—WINTER TERM

Topic for Study.—From the forest to the mill (fig. 22).

Illustrative Material.—Pictures or descriptions, found in periodicals or textbooks or elsewhere, of a lumber camp, logging train, logging sled, logging engine, cableway skidder, big wheel or katydid, skidway, chute, flume, sawmill pond, splash dam, cant hook, peavy, drive, key log, lumberjack, sorting jack, jack chain, slash.

Many excellent motion pictures of such scenes are loaned for educational purposes by certain departments of State and National Governments at cost of transportation only. Motion-picture exhibitors sometimes cooperate with schools in the procuring of such films.

Subject Matter.—Our forests feed sawmills, pulp mills, factories, furnaces, distilleries, at the rate of 212 cubic feet of timber per capita each year, a little more than half of which is saw-log timber and a little less than half is cordwood. The giants of the forests are felled, floated or hauled to the mill, and furnished to the American people in the form of fuel, building materials, fencing, railroad ties, telegraph and telephone poles, paper pulp, mine timbers, cooperage stock, veneer logs, vehicle stock, handles, woodenware, furniture, musical instruments, shingles, and many other necessities, comforts, and luxuries. With this incessant demand of the mills, it is small wonder that we use wood several times as fast as we grow trees or allow them to replace themselves.

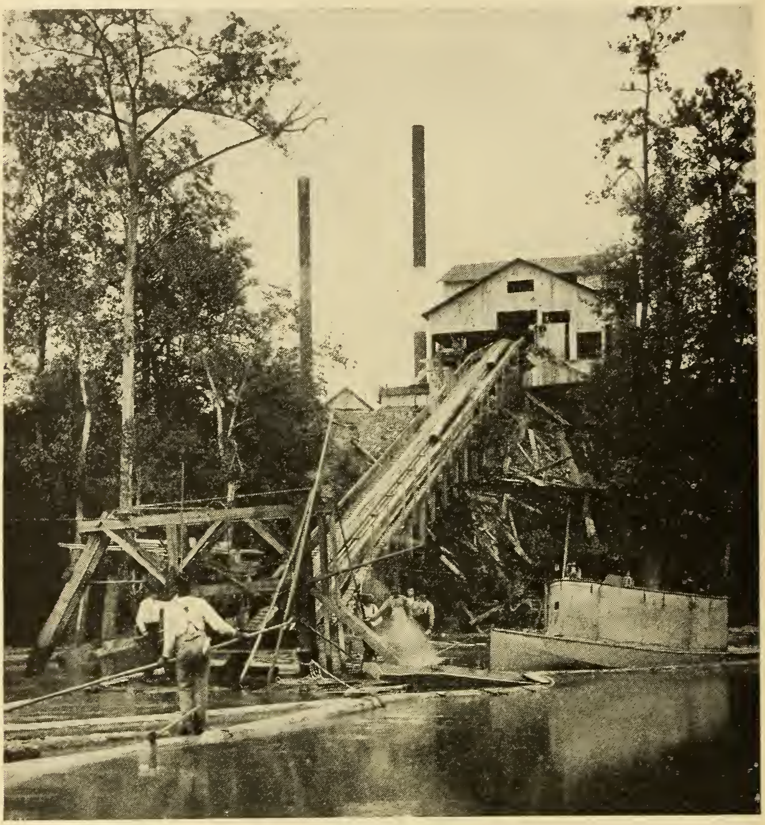


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FIG. 22.—From the forest to the mill

Many adventures overtake the tree during its transformation into useful and valuable things for man's daily needs. It will be an interesting study to follow one such tree through its travels and recognize it in its different appearances.

Study Questions.—How do you get wood from the forest in your part of the country?

Tell what you know of life in a lumber camp.

What are the structural properties of wood?

Mention some of the physical properties of wood.

What are mechanical properties of wood?

Are the usual methods of logging conservative or wasteful?

Why should timber be marked before cutting?

Why is it necessary to protect young growth and seed trees during logging operations?

Why is brush piled and burned in wet weather and under careful supervision?

What are the most up-to-date methods of sawing lumber into boards?

What is "green lumber"?

What is meant by "utilization of waste"?

Practical Exercises.—Visit a sawmill. Study the kind or kinds of lumber cut there. Discuss the uses to which it may be put. Identify other common commercial woods grown in your neighborhood or imported, noting their workable properties.

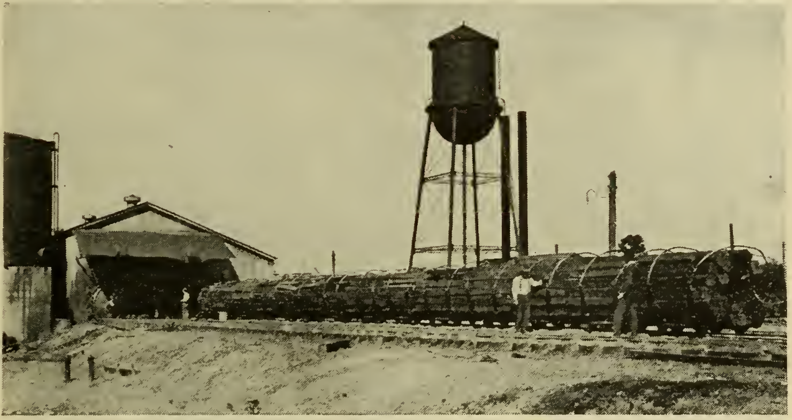
F-151256

FIG. 23.—For length of life and service

Railroad crossties entering cylinder of creosoting plant. The average life of an untreated railroad tie is about 7½ years; of a properly treated tie approximately 15 years.

Discuss seasoning and preservative treatment (fig. 23). If possible, visit a dry kiln and a preservative-treatment plant.

Discuss the work of the Forest Products Laboratory, United States Forest Service, at the University of Wisconsin, Madison, Wis., or similar work at any university or technical school.

Correlations.—Manual arts: Wood as material. Study useful species; most workable species; most common species. Review subject matter of Fifth Year—Winter Term.

Geography: If imported woods are brought to your town to be manufactured, find out where they come from and why they are brought in for use in place of those growing nearer home. What effect does this have on the cost of wood and wooden products?

Suggestions for supplementary readings:

Elementary Woodworking.—Foster.
Logging.—Bryant.
Checking the Waste.—Gregory.

EIGHTH YEAR—SPRING TERM

Topic for Study.—When wood is not wood.

Illustrative Material.—Samples of one or more of the following articles: Paper pulp; artificial silk; linoleum; paints and varnishes; soaps; inks; celluloid; sausage casing; hydrolyzed stock food. Discuss the following products, unsuitable to be brought into the classroom: Gunpowder; wood alcohol; acetylene; chloroform; iodoform. Discuss the manufacture of these articles. Are they direct or indirect forest products?

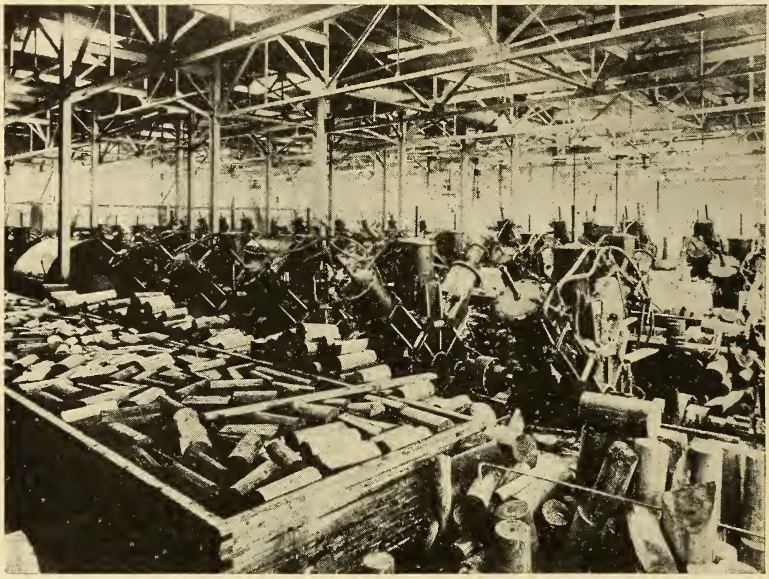

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FIG. 24.—The morning paper in the making

The paper industry of the United States employs over 133,000 persons, is valued at nearly a billion dollars, and consumes each year nearly six million cords of wood, the product of more than a million acres.

Subject Matter.—Wood is a complex chemical substance from which a host of other chemical products can be obtained. The more we know about it the more nearly limitless seem the possibilities in this direction. Already products derived from wood are being used in the manufacture of such important and widely different articles as news and writing paper, linoleum, artificial silk, gunpowder, paints and varnishes, soaps, inks, celluloid, sausage casings, acetylene, chloroform, and iodoform. At present the most conspicuous of these derivatives is paper.

Of the paper now being used in this country 90 per cent is manufactured from wood. The paper industry employs 133,000 persons, has an annual output valued at $907,000,000, and consumes each year nearly 6,000,000 cords of wood, the product of more than a million acres of forest. Over 50 per cent of this is spruce, and the great bulk of the remainder is hemlock, balsam, and the aspens. This means a heavy drain upon the forests of these species.

Tests on the suitability of some 50 species of American woods for the production of chemical pulp and of some 25 species for mechanical pulp have shown to what other woods we can turn as the supply of those now in use gradually becomes exhausted.

Study Questions.—What is meant by "a by-product of the forest"?

Mention one that is a product of the sap.

Name the trees from which certain by-products are obtained.

From what part of the oak, hemlock, chestnut, etc., is tannic acid procured?

In what important industry is it used?

What provision of nature causes the resinous flow from which we obtain turpentine?

From what parts of certain conifers are essential oils extracted?

Name a by-product of each part of the tree—the bark, the wood, the sap, the leaves.

Practical Exercises.—Visit a paper mill and study the processes by which wood pulp is obtained and made into paper.

Visit a wood-distillation plant; a turpentine still; the forest-products laboratory of some university.

Correlations.—Language: Write a short article of not more than 500 words on manufacture and uses of paper; on origin and uses of turpentine; on source of any other by-product of the forest which is familiar to the students.

Geography: Take a journey with your morning paper from the tree in the distant forest to the mill and to the final transformation on the printing press.

History: Discuss the following example of the influence of natural resources upon the industries and the political development of a region:

> One of the many touches of romance in the story of the tree and its uses is that chapter in the history of paper making where the tough grass, called esparto, which grows well on arid, sandy, and rocky land and is found wild over large areas in the Barbary States of North Africa and Spain, was succeeded in preeminence as a paper-pulp material by wood. For over 30 years esparto had been much more important in English paper making than rags, but in one of those changes which follow each other so quickly in modern manufacture, rags had almost ceased to be imported into Great Britain (by 1901), and esparto was far outranked by the predominating wood pulp, which is now making an ever-increasing part of the world's paper * * *. The cheapness of this material greatly reduced the price and depressed the trade in esparto grass, which had been a staple export of many of the Arab tribes of North Africa. The resultant hard times produced discontent which, as is commonly the case, was blamed upon the Government, and the French rulers of Algiers had serious trouble with the tribesmen, who found themselves poverty stricken through the loss that followed the decline in the esparto trade. (Industrial and Commercial Geography. Prof. J. Russell Smith.)

Suggestions for supplementary readings:

Forest Leaves.—Kellerhouse. Forest Fancies.
The Tree Book.—Rogers. Part III, the Uses of Wood.
Trees in Nature, Myth, and Art.—Pythian.

NINTH YEAR—FALL TERM

Topic for Study.—Forests near home.

Illustrative Material.—Figure 25.

USE	ABUSE
The largest owner of timberland and the largest user of timber is the farmer. The farmer's woodland furnishes fuel, fence posts, telephone poles, croosties, logs for veneer, tanbark for making tannic acid, etc. It will pay him to put his idle hand to work growing trees.	The farmer's woodland is often abused, the greatest damage being that done by fire and grazing to young trees and to seedlings. These are broken off, trampled under foot, and sometimes browsed by the animals.

Specimens of products from woodlands in the neighborhood of school or home.

Subject Matter.—Nature has divided the United States into five principal forest regions, which lie for the most part in the eastern and western portions of the country, separated by a comparatively treeless region. Small areas of tropical forest growth are found in southern Florida and Texas. In the so-called treeless region the rivers are generally tree bordered, and the farmers have their shelter belts or windbreaks to protect growing crops against drying winds in summer and chilling winds in winter. Every farmer needs wood for fence posts and other uses. Arbor Day was first observed in the prairie State of Nebraska, where the early settlers found the lack of trees a serious drawback.

Description of the forest land in your county or State: Hilly, rocky, sandy, or swampy.

Character of forest: Hardwoods or softwoods (broad-leaved trees or conifers); virgin or lumbered; dense, thin, or open; mature or young growth.

Treatment which the forest has received: Carefully or destructively cut. Protected from fire, from overgrazing, and from insect infestation and disease, or neglected.

Utilization: Used for saw timber, fuel, fence posts, railroad ties, wood pulp, or for other purposes.

Study Questions.—How many neighborhood trees can you identify?

How many uses of these trees can you name?

Are there any woodworking factories near your home?

What wood products are used on the farms nearest your home?

Are there windbreaks or shelter belts around these farms?

Do the farmers procure farm woodland products, such as fence posts, from their own woodlands or do they bring them from a distance?

Does your farmer neighbor treat his own timber against decay or send it to a commercial or cooperative plant for preservative treatment?

Has the forest nearest your home greatest value for protection of water supply or for wood products? For local needs or for supplying material to distant factories?

Practical Exercises.—Make a map of your school yard, your home grounds, or some near-by farm, carefully locating all trees or woodlands and giving names of species and use or uses to which they may be put.

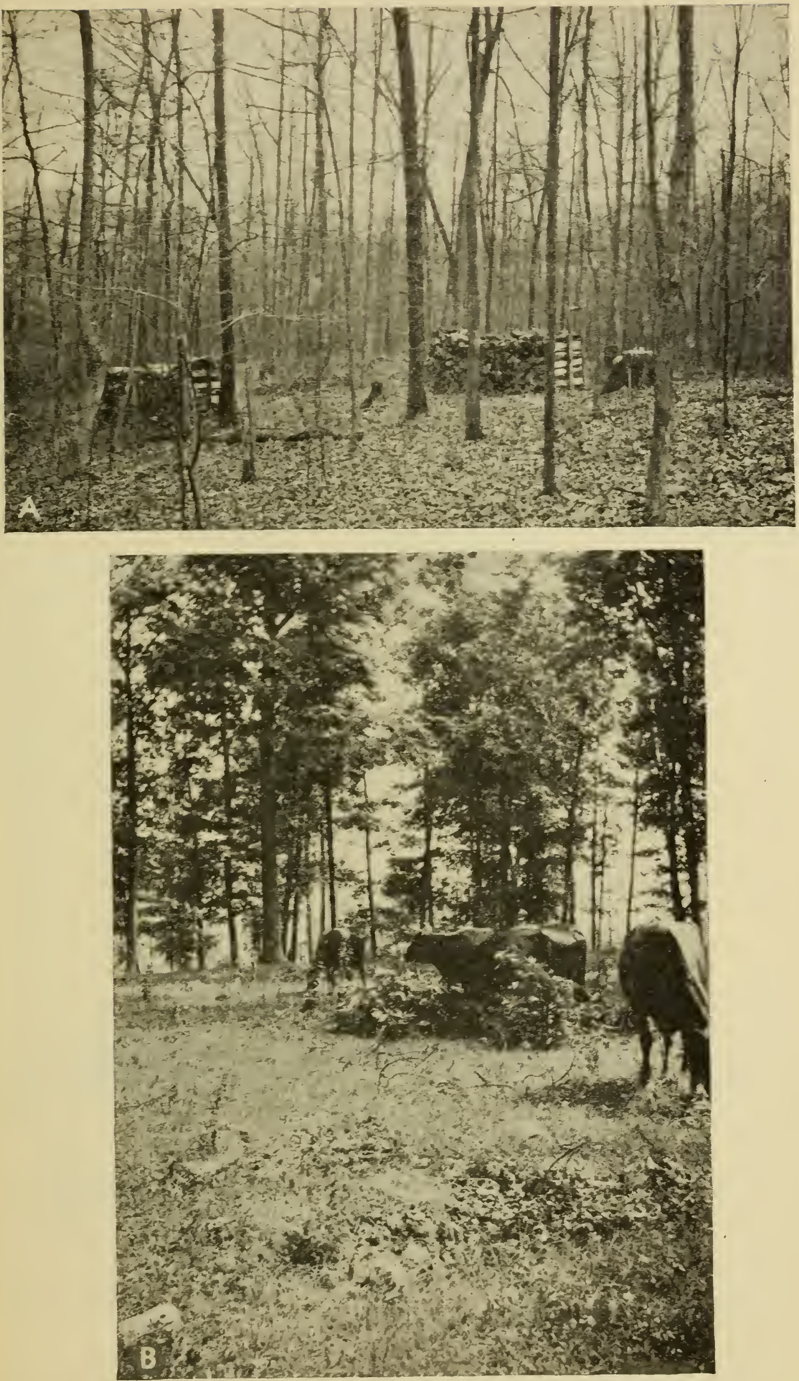

FIG. 25.—A, use; B, abuse

Correlations.—Geography or agriculture: Go into a neighboring woods and see what is happening there. Is the woods located on a thin-soiled, rocky ridge, a hillside with deep soil and good drainage, or a badly drained flat? What kind of trees do you find growing there? What features of the site have encouraged the growth in this spot of these particular species? Is the soil beneath your feet spongy and leaf littered, or compact and grassy? Are the woods open and all trees of about one age, with empty spaces where nothing of value is growing up? Try to account for the even age and the lack of young growth. Are the trees healthy, clean stemmed, and of valuable kinds? In short, is the land fully stocked with good timber trees or is it half idle or working to poor purpose? Is the land more suitable for growing trees than for other use?

Language: If there is a county extension agent in your locality, or a boys' and girls' club working on a forestry project, write a letter asking for information as to what is being done for the trees of your county, and how your school might help. If you do not know of any such agent or club, write to your State agricultural college. Be sure to mention any observations you have made concerning the condition of the woods in your part of the State or county.

History or civics: Find at least one fact connected with the tree growth of your State that bears on the State's history or industrial development. If the State's timber or other forest resources have disappeared or are disappearing, try to find the cause of their disappearance. Instances are the vanishing naval stores of the South; the spruce of New England, so valuable for wood pulp; and the white pine of the Lake States, once the king of construction timbers. If your home is in a region not thickly forested, or entirely devoid of tree growth, consider what effect this fact has had on the mode of life, city building, transportation, etc.

Suggestions for supplementary readings:

Our Field and Forest Trees.—Going.
Constructive Forestry for the Private Owner.—Crumley.
Our Trees and How to Know Them.—Emerson and Weed.

NINTH YEAR—WINTER TERM

Topic for Study.—State and national forests.

Illustrative Materials.—Figure 26, map; our national forests.

Proclamations of Presidents and governors of States setting aside Arbor Days and American Forest Weeks for more careful consideration of ways and means of restoring and preserving our dwindling timber and other forest resources.

State forest map, if one is available.

Subject Matter.—Our prize American crop is neither corn, nor wheat, nor cotton, nor alfalfa, important as these and others are. Timber is the protector of soil and water upon which other crops depend, and at the same time is itself one of the most valuable products of the earth. Then, too, it does its own fertilizing and needs no cultivation. Protection from fire and other damage is its chief demand upon man's time and labor.

The early settlers of America "mined" the forest instead of harvesting it. It was only when the Nation faced a timber shortage that Congress passed laws for the creation and protection of national forests. In 1891 Congress authorized the President to set aside from the public domain "forest reserves," as the national forests were then called, in order to protect the remaining timber on these

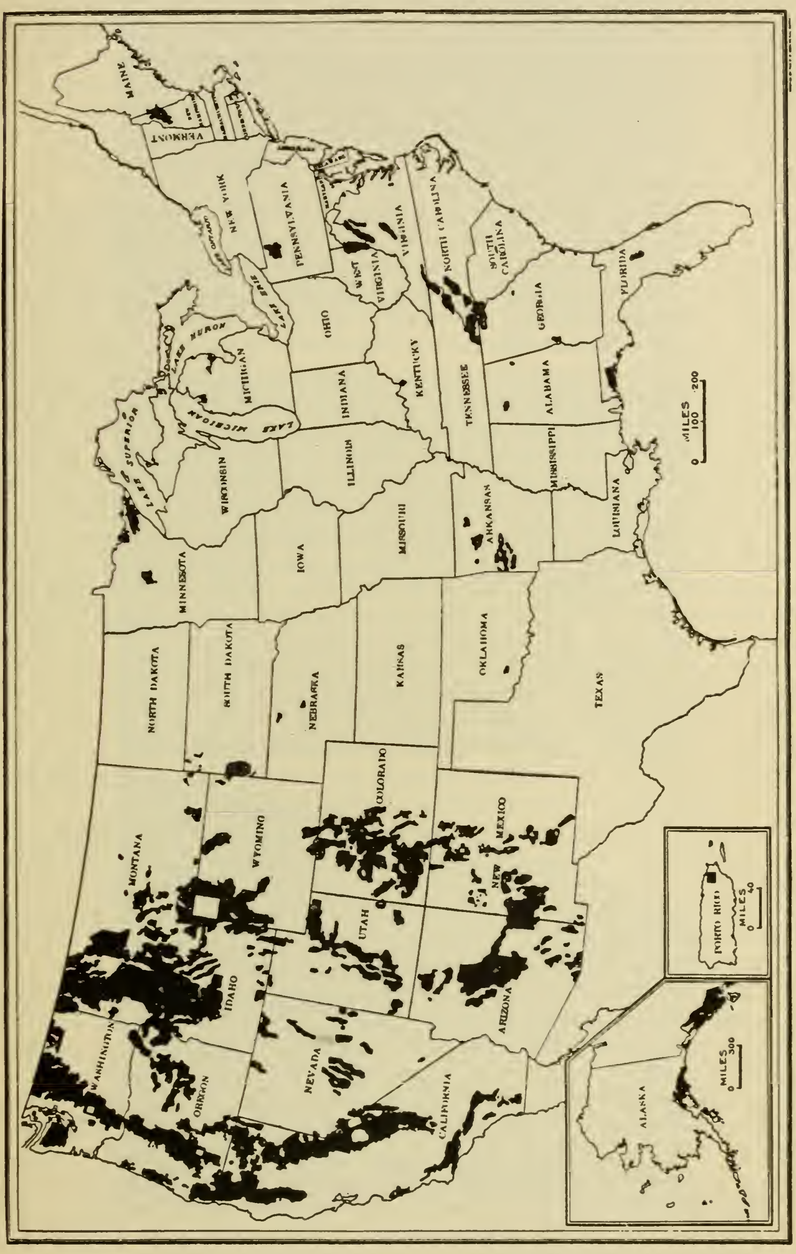

FIG. 26.—Our national forests

areas from destruction and to insure the regular flow of water in the streams. In 1911 the Weeks law passed by Congress inaugurated the purchase of lands at the headwaters of navigable streams in the

Appalachian and White Mountain regions to protect and to increase the supply of forest products. In 1907 the name "forest reserves" was changed by act of Congress to "national forests," to indicate that the resources of these areas are not locked up as "reserves" for a distant future. There are now 160 national forests, including two in Alaska and one in Porto Rico. They are administered by the United States Department of Agriculture through the Forest Service under a policy that aims to make them of the most use to the most people, but especially to the man of small means and to the farmer and settler. Their wood, water, forage, and recreation resources are national—yours and mine.

On the national forests timber valued at millions is marketed each year under careful supervision, and 12,500,000 cattle and sheep of all ages are grazed under regulations which keep the range in good condition. These and other uses of the forests afford a revenue of approximately $5,000,000 annually. At the same time the young growth is protected, other forest resources are conserved, and the forest products laboratory studies means to prevent waste and to bring about better utilization of "Uncle Sam's" self-raising crop.

The Federal Government, in addition to managing the national forests, offers to cooperate with States in the protection of their forests, and 33 States are now sharing the benefits of this cooperation. In 23 of the States areas of publicly owned land have been designated as State forests. The State forests of New York alone total more than 2,000,000 acres. Nurseries for raising forest trees are maintained in 32 States. Thirty-nine States and Porto Rico and Hawaii have State foresters or other officials in charge of work for the protection and development of forests.

Study Questions.—Who is your State forester?

Are there any public forests in your State?

Where and how large are they?

What proportion of the area of your State is forested?

What relation have these forests to water supply for domestic use? For power? For irrigation? For navigation?

Are any of the important industries in your State dependent upon the forests or upon the forest products or influences of neighboring States?

Is any forest planting done in your State? On public or private land, or both?

Are there any national forests near your home?

What industries and activities are being carried on in these forests, State and national (Fig. 27)?

Who owns the forests in the United States that are not State or national forests?

Practical Exercises.—Find out something about the laws of your State concerning the protection of forests and other natural resources.

Study the industries and physiography of your county and consider what effect a change in forest conditions would have on them.

Visit any forest activities or manufactures in your neighborhood and observe their relationship to the welfare of your community, of your State, of the Nation.

Learn to know any forest officer in your vicinity, and if possible talk with him about his work. Ask him to visit your school and talk

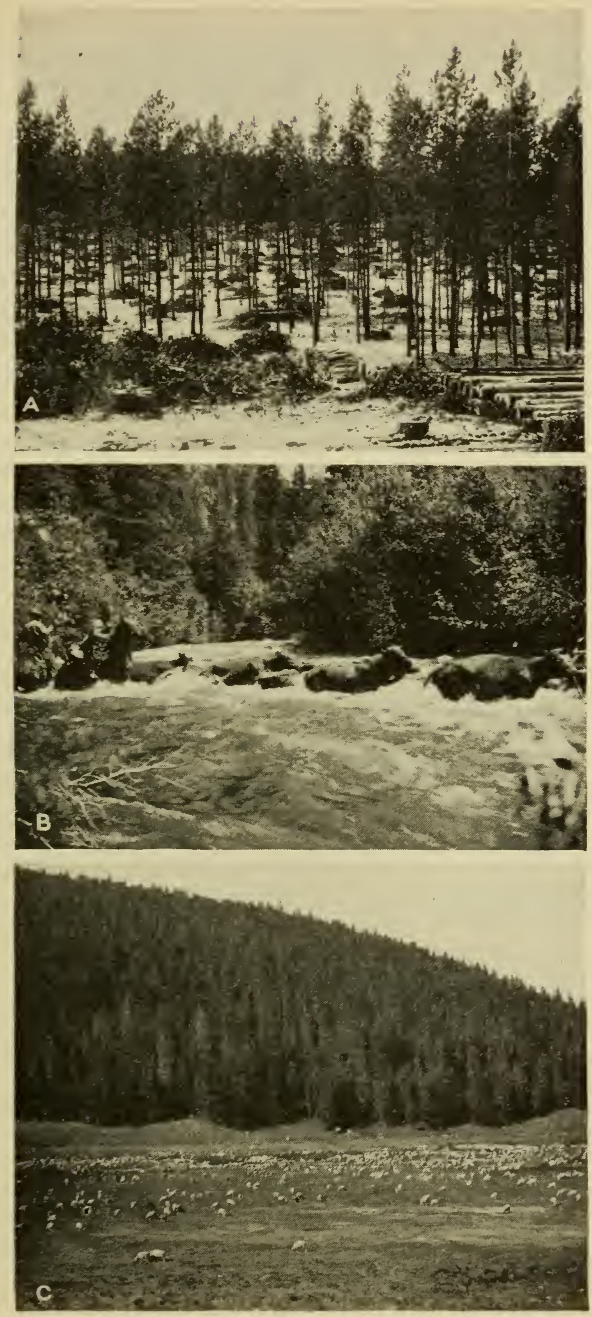

FIG. 27.—Wood, water, and forage

A, good lumbering helps the forest and puts its products to use. Only mature trees should be cut. Young growth should be protected. Seed trees should be left. Logs and cordwood should be stacked for hauling. Brush should be piled and burned or otherwise disposed of, so that it will not become a fire menace or interfere with the establishment of young growth. B, cattle on the way to forest range in Colorado. C, sheep grazing in national forests.

to assemblies or classes. If there is no forest officer in the neighborhood, there may be a county extension agent who is studying a forest project or a member of some college faculty who is particularly interested in forestry. If so, ask him.

Correlations.—Language: Debate such questions as, "Which form of administration is desirable for the forests of our part of the country, private, State, or Federal?"

Geography or civics: Discuss the following charge of the Secretary of Agriculture to the first chief forester from the standpoint of the farmer, of civic welfare, of national progress:

> You will see to it that the water, wood, and forage of these national forests are wisely used and cared for for the greatest good of the greatest number of the people of the United States.

Read and discuss any reference to State forestry matters in the State supplement of your geography.

Suggestions for supplementary readings:

Boys' Book of Forest Rangers.—Crump.
Town Forests.—Reynolds.
A Manual of Trees of North America.—Sargent.
Handbook of Conservation.—Tucker.

NINTH YEAR—SPRING TERM

Topic for Study.—Forestry in America.

Illustrative Material.—Figure 28.

Subject Matter.—As early as 1799, and again in 1831, laws were enacted by Congress with a view of insuring supplies of live oak for ship timbers, etc. It was not until the latter half of the century, however, that the movement for forestry in the United States gained much headway. In the late sixties official inquiries were inaugurated by several States with a view of action to protect their dwindling forest resources. To stimulate tree planting in the prairie country Arbor Day was inaugurated in 1872 in Nebraska. The next year the American Association for the Advancement of Science made provision for submitting to Congress and the several State legislatures a memorial on the need for forest preservation and for recommending legislation. This led to the beginning of work in forestry by the Federal Government in 1876, when a special forestry agent was appointed in the Department of Agriculture to collect forestry information. In 1881 a division of forestry was created in this department, which gradually expanded its investigations. In 1891 Congress authorized the President to create forest reserves from the timberlands of the public domain. This authority was sparingly used until February, 1897, when President Cleveland, just before leaving office, proclaimed more than 20,000,000 acres of new reserves, thus instituting a policy of public ownership and operation of what are now known as national forests.

A few months after President Cleveland created these new forest reserves Congress enacted a law outlining a system of organization and management for these public forests and placing their administration under the Secretary of the Interior. However, the regulation of timber cutting, provisions for the growing of new timber crops, protection of forest ranges against overgrazing, and the management of timber use and grazing use so that water supplies would

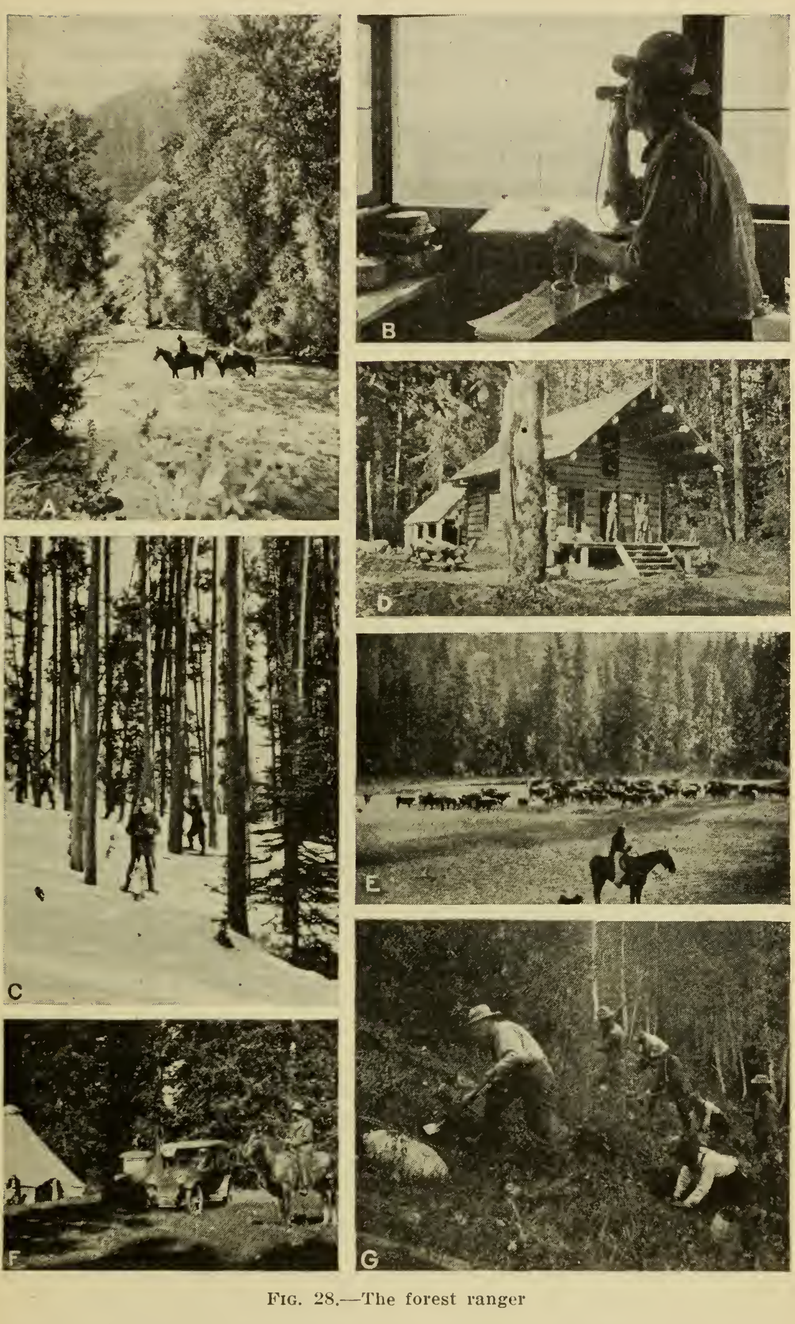

Fig. 28.—The forest ranger

A, on the trail. B, on the lookout. C, marking timber for cutting. D, at home in the heart of the forest. The forest ranger lives close to nature, but is in constant touch with the outside world and the affairs of men by means of his telephone. E, at the round-up of a forest range. F, on the watch. Cautioning campers to be careful with fire. G, any convenient day is "Arbor Day" to the forester.

be maintained and bettered involved technical problems which the Department of the Interior was not prepared to handle. In 1905, therefore, the administration of the forest reserves was transferred to the Department of Agriculture, in charge of the Bureau of Forestry, the name of which was changed two years later to Forest Service. From that time the forest areas set aside for public use have been called national forests.

In 1911 Congress inaugurated the purchase of lands from owners in the Appalachian and White Mountain regions of the East for "the protection of the headwaters of navigable streams." As the Government obtains title to such lands the forests are put under systematic management by the Department of Agriculture, with the object of improving their regulative effect upon stream flow and of increasing the supply of forest products.

The most important forward step in forestry since the creation of the national forests was taken by Congress in 1924, when the Clarke-McNary Act was passed. This act provided for cooperation of the Federal Government with the States in forest-fire prevention and control, in studies of forest taxation, in the production and distribution of tree seeds and seedlings, and in helping farmers to manage their woodlands. The act also authorized continuing the purchase of lands for national forests, begun in 1911, and amended the act passed in that year so as to allow lands to be bought where necessary for timber production as well as for stream-flow protection.

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FIG. 29.—The end of the ranger trail

"Uncle Sam's handy man," the forest ranger (fig. 29), is charged with the care and protection of a subdivision of a national forest averaging 250 square miles in area. The forest itself is in the charge of a forest supervisor, and the eight field districts into which the national forests are grouped are in charge of as many district foresters. The district foresters are lieutenants of the forester at Washington, who in turn is responsible to the Secretary of Agriculture. This organization is called the United States Forest Service.

Many State, municipal, and private forests are protected by similar organizations. Over two-thirds of the States now own and protect State forests.

Study Questions.—What part have the following Presidents taken in the establishment of our national forests: Harrison, Cleveland, Roosevelt, Taft, Wilson, Harding, Coolidge?

Is there a forestry association in your State?

Practical Exercises.—Prepare a program for Arbor Day observance that will include planting of idle lands more suitable for tree planting than for any other use.

Correlations.—Language: Study and write about the following: John Muir, John Burroughs, Theodore Roosevelt, Gifford Pinchot; the scope and purpose of the American Forestry Association, and the forestry association of your State, if it has one.

Civics: Read and discuss the proclamation issued by President Harding (p. 66) urging upon the governors of the various States the observance of "Forest Protection Week"[3] and of the golden anniversary of Arbor Day.

Suggestions for supplementary readings:

The Forestry Almanac.—American Tree Association.
The Forestry Primer.—Pack.
Our National Forests.—Boerker.
North American Forests and Forestry.—Bruncken.
Our Vanishing Forests.—Pack.

SUPPLEMENTARY EXERCISES

A FEW EXPERIMENTS

1. HOW TO MAKE LEAF PRINTS[4]

The materials needed for this exercise are a large, smooth slate or a piece of thick glass about 10 by 12 inches; a tube of printer's ink; two 6-inch rubber rollers, such as photographers use in mounting prints; and several sheets of good quality white paper.

Squeeze a few drops of the printer's ink upon the glass or slate and spread it about with one of the rollers until there is a thin, smooth coat of ink both upon the plate and upon the roller. The ink should never be so thin that it will "run." Now place the leaf on the inky surface of the glass and roll it once or twice on the upper side with the inky roller, until both surfaces of the leaf are well inked. Lay the inked leaf upon a sheet of smooth white paper and cover it carefully with another sheet. Take the clean roller and roll it only once, bearing on hard. An impression of the leaf will be made on both the upper and lower sheets of paper.

(For the older pupils this exercise may be amplified and made much more interesting by using oil colors. The paint may be brushed lightly over the lower side of the leaf, or it may be spread upon the smooth surface within a sketched outline of the leaf and the leaf then pressed upon it with a roller. The impression on paper is then made by rolling the "painted" leaf with a clean roller on white paper, as in the printer's ink process. The lower side of the leaf gives a better print with this process than the upper. The colors used should correspond with those in the leaf itself.)

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[3] This annual observance is now called "American Forest Week."

[4] The writer is indebted to Anna B. Comstock, of Cornell University, for this exercise. Mrs. Comstock gives credit to W. W. Gillett for the idea.

2. TO SHOW HOW THE SAP TRAVELS UP THE STEM

Color a glass of water with a good quality of red ink. Place some cuttings of live branches of maple or willow in this water over night. The next day split one of the branches and notice how the colored fluid has been drawn into and up these stems.

3. TO STORE ACORNS OR NUTS FOR SPRING PLANTING[5]

Gather a quart or more of acorns or nuts. Spread them out on a dirt floor in a cellar or shed for two or three weeks to dry. Then prepare a pit on some well-drained spot in which to store them. Make the pit about 14 inches deep and 10 to 12 inches square. Line the sides and bottom with boards or sink a box of the proper size into the hole to keep out mice and squirrels. Cover the bottom with a layer of clean sand 2 or 3 inches deep. Spread a layer of nuts on this, then another layer of sand, and so on until all the nuts are stored. Then cover the whole with a fine wire screen and with 4 to 6 inches of earth. See that the earth is well heaped up and rounded, so as to drain off all water. Cover the mound thus formed with leaves, straw, or a roof of boards or shingles. When the ground is ready for planting in the spring remove the nuts from the pit and plant them immediately.

4. TO EXAMINE THE FOOD OF A TREE

Bore a hole one-half inch in diameter and 1 inch deep into the trunk of one or more hard maples early in February before the sap begins to flow. Make a spout to fit this hole by forcing the pith out of a section of the stem of an elder and fit this spout tightly into the hole. Place a pail under the spout to catch the sap which flows from it. Measure the daily flow for a number of days. When several quarts of sap have been collected place it in a pan and boil it down until it is a thick sirup, then allow it to cool. Watch for the sugar to form. Where did this sugar come from? What use has the tree for such substances?

5. TO SHOW THE EFFECT OF GIRDLING A TREE

(Select for this experiment some tree which is to be cut down. Do not try it on a good tree, which should not be injured.) Early in the spring remove a strip of bark 2 inches wide clear around the trunk of the tree, leaving the wood entirely exposed. Be sure to cut through the inner bark, so as to leave none of it connecting the bark above the girdle with that below. Watch the effect on the tree. Does it show signs of injury immediately, or not until late in the summer or the next spring? What is the result eventually? Explain.

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[5] For more complete directions as to storage of seeds see United States Department of Agriculture Farmers' Bulletin 1123, Growing and Planting Hardwood Seedlings on the Farm.

6. TO SHOW THAT TREES GIVE OFF WATER THROUGH THEIR LEAVES

Cut about 6 inches from the tip of a growing, leaf-covered twig of some broadleaf tree, such as cottonwood, maple, or basswood. Thrust the butt of the twig through a tight-fitting hole in a sheet of cardboard into a glass of water. Cover the twig with an inverted glass wiped clean and dry. Let stand for 12 hours. Note the moisture which gathers on the inside of the inverted glass. Try the same experiment after stripping the leaves from a twig. Explain why moisture appeared on the glass in the first experiment.

7. TO TRANSPLANT SEEDLINGS BY THE "TIN-CAN" METHOD[6]

Get some small, thrifty seedlings about 6 or 8 inches high, growing in nursery beds or in the open woods or field. Dig them up carefully, allowing as much earth as possible to remain clinging to the roots. Get tin cans, such as tomato cans, in which to plant the seedlings. Across the bottom of each can make two cuts at right angles to provide drainage and allow the roots of the seedlings to go through. Place the seedlings in the cans and fill in rich earth until they are firmly planted. They may now be kept in the schoolroom windows, if the cans are set in a trough or tray so that the little trees can be watered and tended like ordinary potted plants. In the spring set out cans and all in places where it is desired to plant trees. The cans will soon rust away and the little trees will continue to grow unchecked.

If desired, seeds can be planted in the cans and trees grown in this way instead of by transplanting seedlings to the cans.

8. TO ESTIMATE THE HEIGHT OF A TREE, "SHADOW METHOD"

Set a short pole in the earth near the tree so that the shadow of the pole will fall on ground the slope of which is as nearly as possible the same as that on which the shadow of the tree falls. Measure the height of the pole from the surface of the earth, the length of the shadow it casts, and the length of the shadow cast by the tree. The height of the tree may then be computed as follows: Multiply the length of the tree's shadow by the height of the pole, and divide the product by the length of the pole's shadow.

The proportion may be expressed thus: The height of the pole is to the length of its shadow as the height of the tree is to the length of its shadow.

9. TO SHOW WHERE THE INCREASE IN HEIGHT TAKES PLACE IN TREES

In the early spring find a vigorous sapling 2 feet or more in height, with smooth bark, such as a young hickory, box elder, or cottonwood. Cut a notch in the bark at a given height above the ground and another notch about a foot above the first. Record the exact height of the first notch and the distance between it and the second. Now measure the height of the sapling to the topmost terminal bud. Return to the sapling in the fall and repeat the measurements. How much has the tree increased in height? Has either notch been lifted higher above the ground? Have the notches grown farther apart? Where has the new growth taken place? Do you think that the tree in growing pushes its whole trunk upward, stretches that part already built, or merely adds onto its height at the top? After a branch has developed from the trunk, is it lifted higher from the ground by the growth of the tree?

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[6] This exercise is suggested in California Agricultural Experiment Station Circular 59 by E. B. Babcock and Harry A. Greene.

10. TO SHOW THAT A TREE INCREASES IN DIAMETER

Early in the spring select a young, vigorously growing tree 3 to 4 inches in diameter, with a thin bark which peels easily; for example, a willow or a box elder. With a sharp knife make a horizontal cut through the bark about 1 inch long. From each end of this cut make a vertical slit extending upward about 1½ inches. Carefully peel back the flap of bark thus loosened (being sure to expose the sapwood) and place a thin sheet of tinfoil beneath the bark on the exposed surface of the wood. Turn the bark back into its place and seal up the incision with grafting wax. Examine the tinfoil at the close of the growing season. Has the deposit of new wood appeared inside or outside of the tinfoil? Which part, then, builds the tree, the cambium layer or the sapwood? How thick is the layer of wood built this season?

11. TO TEST THE VITALITY OF TREE SEEDS

Gather a quantity of small seeds, such as those of elm or maple. Count out from 50 to 100 seeds and place them on a plate between two sheets of moist blotting paper. Record on a slip of paper the number and species of the seeds, with the date on which the test is begun. Place this slip on the edge of the plate so that it will not get lost or separated from the seeds it represents. Cover the whole with another plate or a pane of glass. Keep in a warm room, in which the temperature is not less than 68° F. Keep the blotting paper moist. Examine the seeds every day until all have had time to germinate. This may take two weeks, or even longer. When the seeds are well sprouted count out those which failed to germinate, and from this determine the percentage of good seeds.

12. TO SHOW THAT FORESTS PREVENT EROSION OF THE SOIL

Prepare a mound of loose, fresh earth about 2 feet in diameter at the base and from 12 to 14 inches high. Pack the mound so as to approximate the natural condition of the earth's surface. Cover one side of this mound with moss, being careful to leave none of the surface exposed, and thrust small twigs of evergreen into the moss so as to make a miniature forest. Leave the other side bare. Now, with a common garden watering pot sprinkle water upon the mound, first on the " forested " side, then on the barren side, from a height of 3 feet or more. Note how the water gullies the bare slope and runs off in muddy streams at its base, while the "forest-covered" slope is protected from erosion and the water running off it remains clear. Note also that when the sprinkling is begun the run-off is more rapid from the barren slope than from the moss-covered side. What does this suggest as to the effect of the removal of forests from mountain sides?

13. TO SHOW THAT TREES AND OTHER VEGETATION ARE AN IMPORTANT AGENT OF NATURE FOR CONVEYING THE MOISTURE OF THE EARTH INTO THE AIR

We have been in the habit of thinking that the clouds get most of their moisture from the vast ocean. But in fact by far the greater part of the moisture is drawn up from the soil through the trees and plants. Here is a little experiment to show that plants assist in the evaporation of water: Take two glasses of equal size and fill them with water, then place them in the direct sunlight in the open air. Into one put a few leafy cuttings of a growing plant. In a few hours the water will disappear from the glass containing the cuttings and that in the other glass will scarcely be diminished.

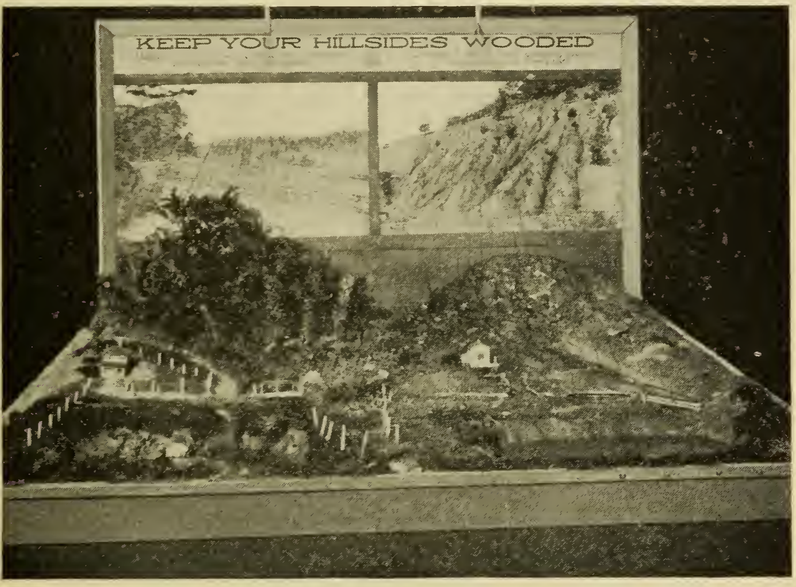

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FIG. 30.—Model used to demonstrate the effects of deforesting slopes

Simpler models can be made by ingenious pupils, and Experiment 12 given above will teach the lesson if carefully explained by the teacher.

14. TO TELL IN WHAT YEAR ANY PART OF A TREE TWIG GREW[7]

Put a horse-chestnut twig in water and leave it in a warm room. The bud at the tip will grow into an extension of the branch and the scales will finally drop away, leaving scars where they were attached. So the rings on the horse-chestnut branches are made by bud scales, and mark the beginning of each new season's growth, and the part between each set of rings represents the growth of one year. Thus the tip grew in the year previous to the experiment, and so on.

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[7] From "Seeing Nature First," Weed.

15. TO FORCE WINTER BUDS IN FEBRUARY AND EARLY MARCH[8]

Get from convenient trees some twigs at least 2 feet long, with vigorous buds. Twigs of cherry, plum, apple, maple, elm, horse-chestnut, or any other common tree are suitable for this experiment. Put them in jars of water and set them on a convenient window shelf where they get the sun. Give them plenty of water and do not crowd them. It is not necessary to change the water. Cutting the end slanting and under water every few days will insure the unimpeded flow of the water up the stems and the more rapid development of the buds.

THE FOREST YEAR

(For discussion or study and correlation with language and art work)

THOUGHTS ABOUT TREES IN FALL

Coloring of the leaves.
Nuts and fruits of familiar trees.
The changing outline.
Tree groups in the color scheme of autumn.
Young trees coming into prominence.
Migratory birds seeking insect food.
The dance of the falling leaves.
Nature's way of covering the leaf scars.
The carpet of fallen leaves.
The "lullaby" of the trees.
The forest animals get ready for winter.
The tree as commissary and storehouse.
The falling asleep of the roots and twigs.
The hunted creatures of the autumn woods.
The guardian evergreens.

THOUGHTS ABOUT TREES IN WINTER

General outline (red spruce, elm).
Bark of the trunk, beeches.
Buds and spines upon the twigs, horse-chustnut.
Fruit persisting after leaves have fallen, honey locust.
Smell and taste of barks.
Age of tree, horse-chestnut twig, rings.
Relation tree has established with sunlight.
Evidences of tree's battles with its enemies—fire, wind, insects.
The tree's cooperation with its friends.
Parasitic fungi and insects that live upon trunks and limbs.
Birds that search for winter insects.
Shutting up shop.

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[8] From "The Tree Book," Rogers.

Winter work of the fallen leaves.
Protection of spring buds from frost and ice.
The echo of the ax of the lumberman.

THOUGHTS ABOUT TREES IN SPRING

The awakening stir of the nightcapped buds.
The stretch and shake of the sleepy branches.
The murmur of the melting snows.
The chatter of the brooks and springs.
The floral festival.
Seed babies.
Full leaf.
The newly clad forest.
The coming-out party of the juniors.
Renewing acquaintance with the forest folk.
The tender leaves are thirsty and hungry.
The roots get busy.
The lifeblood of the tree flows steadily once more.
Visitors to the gleeful woods.
Last year's leaves nourish the spring carpet of flowers.

THOUGHTS ABOUT TREES IN SUMMER

The root pumps in constant motion.
The laboratory of the leaves at maximum output.
The lifeblood sap is rich and active.
The cambium is turning out new wood each day.
At home in the cool forest.
What the trees do for farm and mill and power house.
The tightening hold on the restless soil.
The forested hillside hand in hand with the fertile plain.
The forest as a cooperative friend.
The forest as an industrial ally.
The forest in geography.
The forest in history.
The forest in art.
The forest in religion.
The forest in our daily lives.

FIELD TRIPS

Field trips are at once the best and the most difficult means of studying the forest. They enable the pupil to study the trees at first hand in their natural state, which is without doubt the ideal method. But this method is difficult, because the pupil generally feels that the discipline of the schoolroom is relaxed as soon as the threshold is crossed and that study is impossible without books. An outdoor lesson, therefore, must have the most careful preparation if it is to yield results commensurate with the effort and time it requires.

An aimless trip is likely to be a disastrous one. The first duty of the teacher, then, is to lay out a careful plan for the undertaking. It is advisable for the instructor to go over the ground in advance, looking for features that may be studied with economy of time, effort, and distance to be covered. A memorandum should be kept of special features to be called to the attention of the pupils. This will enable the instructor to refresh his memory on important details and prevent embarrassing and time-wasting delays. The advance trip will also serve to increase the teacher's stock of information and arm him with a reserve fund of knowledge better than he can obtain from any reference books.

In some localities the first problem will be to find a piece of woodland within easy reach and suitable for study. In other localities choice must be made among several possible routes. The nature of the work planned will depend largely upon the forest conditions of the vicinity. Of course the most desirable field of operation is a large tract of closely wooded land, but even if a few trees along some stream are all that can be found, there will still be opportunity to teach some of the elementary principles of forestry.

When the route to be followed has been decided on, the next step is to plan the equipment for the trip. In most cases no tools will be necessary but a sharp hatchet, a spade, and several sharp jackknives such as every boy habitually carries. A market basket should be provided in which to carry home specimens. A camera will lend additional interest to the occasion and enable the possessor to bring back pictures which will refresh the minds of the students and permanently illustrate the lessons learned. A magnifying glass or hand reading glass of moderate power is also desirable.

Visits to the woods should be followed by trips to points bearing evidences of the influence of the forest on the physical geography of the neighborhood, as well as to industrial plants using products of the forest, or near-by farms the equipment of which is dependent upon forest material. A first-hand study of the town or city water supply, following it to its source if possible, will teach a most valuable lesson. Any trip that demonstrates the part which trees and forests bear in community welfare or in the history and geography of a locality will be most interesting and profitable.

The most important step in getting ready for a field trip is the preparation of the minds of the pupils. They must be interested to a point where they will look forward to more than a mere pleasure excursion. The trip must seem to them an unusually interesting sort of lesson, but nevertheless an actual part of their school work.

The experience of most teachers has probably been that children are easily interested in anything that partakes of the nature of a story. As a means of making a field trip interesting to the pupils, it is a good plan for the teacher to give a series of simple talks about trees and their habits, bringing out in this manner as many as possible of the features which the pupils will have opportunity to observe on the trip. Tell them that if they look carefully they may see these things for themselves. Encourage a spirit of friendly rivalry among the pupils as to who can first find the things mentioned and who can report on the largest number.

Each child must feel that he is to be held responsible for this lesson quite as much as if it were from his books. Some sort of report or composition, based on the things seen and learned, should be required, at least of the older pupils. Each of these trips can usually be made the basis of several lessons in written English, thus serving a double purpose. With the younger pupils the same end can be achieved by oral discussion of the features studied.

A great lesson that should be taught to every pupil is the proper care and preservation of the forests. All field studies should be thoroughly constructive, and never destructive. Make it a rule never to dig up a seedling that promises to develop into a useful tree unless to transplant it to a better location. Never cut a branch that there is no reason for cutting. There are plenty that may be cut with benefit to the trees from which they are removed. Be careful also in cutting limbs not to leave ragged, projecting stumps, which may make wounds the trees will be unable to heal over and thus cause decay and permanent injury to the tree. Care in this respect will more than repay any effort in discipline it may cost.

SCHOOL WOODLAND

A school woodland will be especially beneficial in the work of seventh, eighth, and ninth grades, or junior high school work. Many suggestions for the study and care of such a woodland are given in United States Department of Agriculture Bulletin No. 863, "Forestry Lessons in Home Woodlands," which may be obtained from the Superintendent of Documents, Government Printing Office, for 10 cents a copy.

A FOREST CALENDAR

A calendar that records observations on tree life and habits is of value in any course in nature study. Different forms are here described, and the originality of the pupils may suggest others. The important point is the educational influence of observing and recording accurately the manifestations of tree life. On page 10 was suggested a form of calendar for use in studying individual species. The following form is suggested for study of seasonal forest life:

Get some sheets of three-ply bristol board or mounting board and cut them into sheets of a size that will be convenient for a wall calendar, for instance, 8 by 10 inches. Prepare one sheet for each month. A pad containing the calendar dates may be purchased for a small sum at any stationery store. Separate the pages for the various months and mount one on each sheet of the wall calendar.

Now select some phase or condition of forest life suitable for study in each month. Select also certain trees which typify this phase or condition. One tree may be studied each month or each week, as time permits. The following topics and trees are suggested. Others may be substituted as desired.

September	Leaf fall. Walnut, post oak, holly, larch.
October	The fruits of trees. Chestnut, hawthorne, Scotch pine, eastern red cedar (juniper).
November	The coats of trees. Sycamore, shagbark hickory, birch, honey locust.
December	Shapes of trees. American elm, Lombardy poplar, balsam fir, weeping willow, eastern red cedar (juniper).
January	Lumber from trees. White pine, white oak, yellow poplar (tulip tree), cypress, hickory.

February	Miscellaneous products of trees. Long-leaf pine, sugar maple, tanbark oak, spruce, hemlock.
March	Tree planting. Pin oak, jack pine, catalpa, gingko.
April	Tree blossoms. Dogwood, red maple, yellow poplar (tulip tree), magnolia, wild cherry.
May	Leaves of trees. Aspen, horse-chestnut, cedar, hemlock.
June	Seeding of trees. Cottonwood, box elder, basswood, cherry.

The calendar may be used to illustrate these topics in various ways. One way is to mount on each of the pages of the calendar pictures of one or more of the trees listed under each month and to write opposite each picture a description of the tree and the interesting thing for which it stands in relation to the topic assigned for that month. For example, in connection with the general study of " leaf fall," in September, it could be pointed out that the walnut is a typical deciduous tree; that the post oak is a deciduous tree whose leaves, although dying each autumn, frequently cling to the twigs through the winter; that the larch is a type of deciduous cone-bearing tree; and that the holly is an evergreen broadleaf tree. Again, in connection with "shapes of trees," in December, the difference between the form and branching of trees in the open and in the forest may be brought out, as in Figure 4.

Additional facts of interest about each tree may be recorded on the calendar. The pupils should be encouraged to watch for peculiarities in the habits of various trees and report them to the school; for example, when the tree blossoms, when its leaves and fruit appear. Each pupil thus contributing to the calendar may be rewarded by the entry of his name on the calendar after the fact discovered.

In addition to this material, facts concerning the forest in general, learned through actual observation, should be entered. The teacher may also select from literature quotations about the trees being studied for the pupils to memorize. After each tree has been discussed, a good supplementary exercise in composition may be had by asking the pupils to write out in story form all they have learned about the tree.

Where pictures can not be obtained, or as a supplement to pictures, leaves of trees may be pressed and mounted upon the calendar pages. Specimens of the wood also may be used, or leaf prints made as suggested on page 51 of this circular. Water-color drawings of trees, leaves, or fruits will make attractive contributions.

The completed calendar may be hung upon the school walls as a souvenir. It will be not only interesting but instructive as well, and useful to pupils and teachers in succeeding years.

MOTION-PICTURE OUTINGS

The motion picture offers an abundance of material for visual education. Films showing beautiful woods scenery, forest industries, and the manufacture and use of forest products are available in many cities and towns and can sometimes be borrowed for educational purposes from Government bureaus (State or national) at the cost of transportation. The ingenious teacher, or one trained in the educational use of motion pictures, can make excellent use of them as illustrative material or to take the place of trips to the woods. The most up-to-date use of the motion picture in the schoolroom calls for a regular program of observation and study. There should be (1) a presentation for arousing general interest, followed by (2) a primary quiz to quicken the interest; (3) a second presentation to rivet the attention and fix impressions; (4) assignment of topics connected with the picture story or locality, according to the correlation of subject; (5) a third presentation; and (6) a final quiz to bring out the points overlooked and complete a thorough study and appreciation of the pictured story.

RADIO RAMBLES

If radio equipment is available in the school, watch for radio programs bearing on forestry or tree study. All schools should be provided with facilities for receiving the valuable educational material that is on the air. This is one of the new phases of education and may be made an interesting school activity.

A FOREST MUSEUM

Nothing can be of greater benefit to a pupil who is studying about the products of the forest than actually to see and study these products in both the raw and the manufactured forms. It will be well worth while, therefore, for any school that attempts to study the forest to begin as early as possible to collect samples of forest products and of materials that give information about the industries in which these products are used or manufactured. Supplemented with sets of pictures, this collection will form a little "forest museum."

Specimens may be obtained from various sources. Some may be taken directly from trees in the vicinity. The local grocery stores, drug stores, or hardware stores will supply a great many. Others may be obtained by exchange with schools in other localities. If enough local interest is aroused in the subject, patrons of the school may contribute to the project either by helping to bear the expense or by donating material.

The success of this undertaking will depend largely on how the specimens are prepared for use. First of all, they should be carefully marked with labels telling exactly what the articles are, where they were produced in the raw state and by what trees, their use commercially or otherwise, and anything else that is desirable for reference. Specimens of manufactured products should, if possible, be arranged in series to show the processes and stages in manufacture. A dust-proof case or cabinet with glass front is extremely desirable in order to protect the specimens from dust and from handling when not in use. If a suitable cabinet can not be procured ready made, one can easily be made by any carpenter or cabinetmaker.

The materials collected for the forest museum should be used, not merely displayed. As far as possible the specimens should be so prepared that they may be handled and closely studied by the pupils without injury. Interest soon wanes in blocks of wood or samples of wood products shut up behind glass cases or protected by the warning sign "Hands Off." The child wants to handle the objects he studies, not merely to gaze at them through panes of glass. As far as possible, the pupils themselves should gather the specimens. They should be encouraged to think of the collection as their museum. It would defeat this aim to deprive them of the privilege of using and handling the specimens, since they can not but feel that they have a right to use what is their own.

Of course, the rare or delicate specimens will not bear handling and must necessarily be used for display only. But the real value of the museum will come from the "working collection." The material collected for the museum should be prepared and arranged with the aim of use constantly in view. If it is possible to display the materials when they are not in use, this should be done; but the usefulness of the collection should not be sacrificed for the sake of making an attractive display.

COLLECTION OF WOOD SPECIMENS

The pupils should be encouraged to make collections of specimens of woods found in the locality of the school. A number of possible ways of preparing and mounting such specimens will doubtless suggest themselves, but the following method is recommended as likely to prove convenient and satisfactory:

1. Whenever possible use seasoned woods for the specimens. If nothing but green wood is available, cut rough sticks and allow them to dry as thoroughly as possible before preparing the finished specimen.

2. Collect specimens as nearly as possible uniform in size and character as to the parts of the trees and ages of the trees from which they are taken. If some are taken from the branches and some from the trunks, or some from young saplings and others from old trees, they should be marked accordingly.

3. For each specimen select a stick about 2 or 3 inches in diameter and cut from it a section about 4 inches long, sawing the ends squarely across. Split or saw this block through the center and smooth the split or sawed surface so as to show the grain longitudinally. Beginning about 1 inch back from the end on the bark-covered surface, cut with a sharp knife out to the end at the flattened surface, so as to slope one end. Now, if the wood is thoroughly dry and well seasoned, sandpaper the flat surfaces well. A single coat of thin varnish or shellac will add to the appearance of the specimen by bringing out the grain.

4. Probably the best plan to follow in mounting a specimen is to insert a small screw eye into the square-cut end of the block prepared as above described, and hang it on a hook in the wall or cabinet. The specimens can then be taken down for use in the classroom, and can be packed in a small space if it is desired to move them about.

5. Great care should be taken to see that each specimen is properly labeled. When the sections are first cut they should be carefully marked so that each one may easily be identified, and these marks should be kept on the specimens until they are finally labeled. The

label should state the name of the tree; whether the specimen was taken from trunk or branch; whether from an old tree or a sapling; locality and habitat; and, possibly, the uses of the wood, especially in the case of woods like hickory or oak, which are employed in the manufacture of implements and furniture or other special uses.

COLLECTION OF COMMERCIAL PRODUCTS OF THE FOREST

The grocery store, drug store, and hardware and other stores will yield a great variety of products derived originally from the forest. An interesting plan will be to try to obtain samples or specimens of all such products, not only in the manufactured form in which they appear on the market, but also in the raw state and in various stages of manufacture. A suggestive list of such products is given below:

Food products, such as the nuts and fruits of forest trees, maple sugar and sirup.

Medicinal products, such as quinine from cinchona, salicin from willow bark, oil of sassafras from sassafras bark, etc.

Small household articles, matches, toothpicks, clothespins, pencils, penholders, tool handles, wooden baskets, shoe pegs, and wooden dishes.

Oils, such as eucalyptus oil, beechnut oil, olive oil, pine oil, etc.

The products of wood distillation, such as wood alcohol and acetates, wood tar, common potash, from wood ashes, and charcoal, the residue of wood distillation.

Paper pulp in various stages of manufacture.

Other articles manufactured from wood pulp, such as artificial silk cloth and hosiery, paper cord and twine, woven paper bags, paper rug yarn, paper furniture braid, and smokeless powder.

Naval stores and their related products, such as turpentine, rosin, creosote, etc.

Miscellaneous products, such as cork, tannic acid, spruce gum, lampblack, and excelsior.

Some of the products listed, such as maple sirup and sugar, turpentine, wood alcohol, and the various gums and fluids, must, of course, be kept in vials. Perishable fruits should be preserved in alcohol in small jars. Other articles, such as specimens of paper or small articles of woodenware, may be mounted on sheets of cardboard.

TREE CLUBS

As a supplement to nature study or botany, or in fact to language, manual training, art, geography, and other branches, a grade may be divided into clubs, each studying a particular tree species or genus, the oaks, the maples, the pines, etc., as to habits of growth, habitat, utilization, insect enemies, susceptibility to fire and other damage, and other characteristics and relations. Such a study is capable of endless application and variation, and will hold the interest of any normal child or youth. The results may be used also to demonstrate the influence of tree life on community, State, or national welfare.

TREE MAPS OF CITY STREETS, PARKS, OR HIGHWAYS

As a spring and fall project, the mapping of tree species and arrangement in city streets or parks or along highways is a fertile source of profitable and healthful exercise and observation. In a grade undertaking this work the area to be studied may be divided into sections, the results reported in a general conference, and a combination map made up from the various observations. If there is time, the sections of the area may be interchanged and reports compared.

AMATEUR FOREST ENTOMOLOGY

School children trained to an interest in trees and forests and an appreciation of their relation to human needs may readily become skillful assistants in the detection and control of insects that attack trees. They may keep a careful watch on trees subject to attack, and may scrape larvae from infested trunk and branches and burn them or carry them to an expert for study or disposal. Prizes may be offered for the greatest " find."

UTILIZATION OF NATIVE WOODS FOR NOVELTIES IN MANUAL ARTS

Useful and beautiful foot rules may be made of inch squares of native woods. If the number of available woods permits, the rule may be constructed with a double face and utilize 24 different species. If the student writes out a description of each kind of wood used, to be kept with the rule, the educational value of this project will be greatly increased.

Checkerboards and other novelties of the kind may be made of alternating squares of light and dark woods. There is no end to the opportunity offered to the manual-training teacher to correlate his subject with junior forestry.

TRANSPARENCY FOR SCHOOLROOM WINDOW

Between the lower pane of the schoolroom window and an inside pane of the same size fastened against it a winter garden of pressed flowers and autumn leaves may be preserved to lend color and interest to the dreary outlook of the "melancholy days." When the crystal landscapes of frosty days are added on the outer pane as a background to the colored flowers and leaves the effect is magical. The cost is merely the price of an extra pane of glass, since the work of adjusting it can be done by any ingenious pupil, and the arrangement of pressed foliage is a delight to children of any age.

QUESTIONS FOR QUICK WITS

Why is the pine tree called " the tree of silence " ?

Who used the phrase " murmuring pines," and in what poem?

Why has the horse-chestnut been called " the giant's nosegay " ?

Why has the pussy willow been called a " compass plant " ?

Why has the " cambium " or inner bark been called the " carpenter " of the tree?

Why are the outer layers of bark on many old trees furrowed and broken?

Why does the sycamore or the birch tree have a smoother trunk than an oak or elm of the same age?

Why should we be careful in pruning or clipping a tree or shrub to make a smooth, clean cut ,without tearing the surrounding bark?

Have you ever seen a tree "asleep"? On sunny or on cloudy days?

What makes the tree grow erect?

Why have the leaves been called "the lungs of the tree"?

How do birds pay for board and lodging?

What little animal is a busy tree planter?

What is meant by the saying, "The blue jay lends wings to the acorn"?

A young pine was found growing some 10 feet from the ground in the fork of a maple by a roadside. There were no other pines near? What planted the little pine there?

Why is it that a leafless tree can not grow?

What great enemy of the forest has been called "the red terror"?

What is meant by this slogan for campers and picnickers in the woods:

> A match has a head but doesn't think; you must think for it.

Forty-seven different kinds of birds feed on the fruit of the dogwood. Do they help or hurt the dogwood family?

What is meant by "the candles of the pine"?

What share have the forests had in the history making of the following nations: Phoenicia, Rome, England, Scandinavia, America? Or the loss of forests in Palestine; in China?

What poet wrote, "The groves were God's first temples"?

What is the worst evil to be feared on the treeless desert?

Could you live as you do now without the useful trees?

Take a journey anywhere from your home. How far could you go without touching wood?

If the pine forests of Georgia and Florida were burned or cut away, would grapefruit and oranges be as cheap as they are now?

In Athens, Ga., there is a tree that owns itself, by deed of gift from a chief justice of the supreme court of that State, declared legal by an associate judge of the same court. Can you give a reason for such an act?

What is meant by the saying, "The tree is the mother of the fountain"?

Why is the Hoang-Ho in China sometimes called the "Yellow River," and sometimes "China's Sorrow"?

Why is it fitting that Nebraska should have been the first State to observe Arbor Day?

It is said that Thomas Jefferson, viewing for the first time the prairie stretching to the west of the Appalachian highland, exclaimed: "Here ends civilization!" Can you give a possible reason for this exclamation?

Can you tell a short story about the forest as it might have been told by one of the following:

King Solomon.
Christopher Columbus.
A "Forty-niner."
A daily paper.
A farmer.
An artist.
A musician.
John Burroughs.
William the Conqueror.
Capt. John Smith.
Theodore Roosevelt.
A "lumber baron."
A railroad president.
A house builder.
"The Red Terror."
General Pershing.

How did John Muir discover that many of the big trees of California are of prehistoric age?

Can you explain the poet Schiller's meaning in the following true story:

> While visiting a forester in the Thuringer Wald, Schiller found in his friend's study one day a map of his forest showing the cuttings that would be made during the next 220 years. When Schiller realized the extent and perfection of these plans he said: "You foresters work quietly and entirely free from hopes of reward, while the fruits of your work ripen for a late posterity. Hero and poet attain a vain glory; I should like to be a forester!"

This care of our trees and woods and forests, what does it mean to you? Will it mean anything to your children? Will your grandchildren have nature study and forestry to think about?

PLANTING PLAN OF JOHN BURROUGHS

Here is what John Burroughs, a great lover of nature, wrote to the principal of schools in a Pennsylvania town:

> I am glad to hear that your pupils are going to keep Arbor Day; if you can teach them to love and to cherish trees, you will teach them a very valuable lesson.
>
> * * * Give the tree roots plenty of room and a soft, deep bed to rest in; tuck it up carefully with your hands. The roots of the tree are much more soft and tender than its branches and can not be handled too gently. It is as important to know how to dig up a tree as how to plant it. A friend of mine brings quite large hemlocks from the woods and plants them on his grounds and has no trouble to make them live. He does much of the work with his hands, follows the roots along and lifts them gently from the soil, and never allows them to dry. The real feeders of the tree are very small, mere threads; the bulky, muscular roots are for strength; its life is in the rootlets that fringe them, and to let these delicate feeders dry, even by an hour's exposure to a drying air, is to endanger the vitality of the tree. By the way, in your planting do not forget the hemlock. It is a clean, healthy, handsome tree. Do not forget the ash, either, if only for the beautiful plum-colored foliage in autumn. Above all, do not forget the linden or basswood, a tree generally overlooked by our arborists. It is as pleasing as maple in form and foliage, and then it is such a friend of the honey bee. What a harvest they get from it, and just when other sources of honey supply begin to fail.
>
> I have somewhere said that when you bait your hook with your heart the fish always bite, and I will now say that when you plant a tree with love it always lives; you do it with such care and thoroughness.

Among notable presidential proclamations concerning the welfare of the people of the United States the following is appropriate for use in Arbor Day exercises and on similar occasions:

FOREST PROTECTION WEEK[9] AND GOLDEN ANNIVERSARY OF ARBOR DAY, 1922

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

A PROCLAMATION

Whereas the protection and perpetuation of our forests are vital to our continued industrial welfare and national strength, and to our individual health, comfort, and prosperity; and

Whereas a period of fifty years has passed since, in April, 1872, there was instituted in the State of Nebraska observance of a day especially set apart and consecrated for tree planting, and known as Arbor Day; and

Whereas both through widespread annual celebration of Arbor Day and through the increasing observance of Forest Protection Week public attention

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[9] This annual observance is now known as American Forest Week.

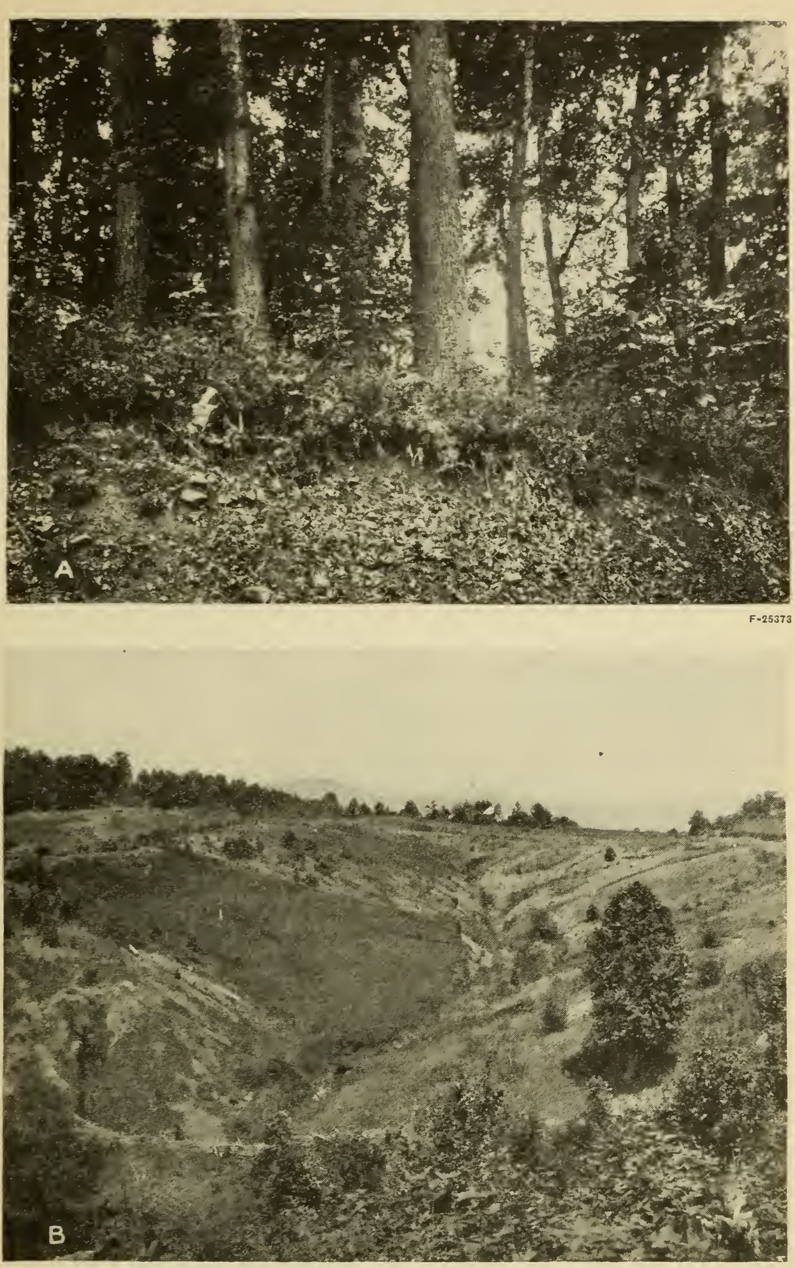

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FIG. 31.—At the root of the whole matter. Unlike most crops, trees continually enrich the soil in which they grow

A, leaf fall each season adds a new coat of vegetable matter that decays and forms rich humus. The tree draws nourishment from this fertile soil. The roots bind the soil and keep it from washing away. B, where the forest has been removed from the hillsides. The soil is being washed away, the fertility of the field is being destroyed, because there is no forest to prevent the rain water rushing down in flood, no tree roots to bind the soil, no forest humus to enrich it.

has been commendably directed to the value of trees, the unnecessary waste of our diminishing forests through preventable fires, the deplorable effects of forest devastation, and the need for remedial measures against depletion of an essential natural resource.

Therefore I, Warren G. Harding, President of the United States, do urge upon the governors of the various States to designate and set apart the week of April 16–22, 1922, as Forest Protection Week, and the last day of that week, April 22, as the Golden Anniversary of Arbor Day, and to request officers of public instruction of counties, cities, and towns, and of civic and commercial organizations to unite in thought and action for the preservation of our common heritage by planning such educational and instructive exercises as shall bring before the people the disastrous effects of the present waste by forest fires, and the need of individual and collective effort to conserve the forests and increase our tree growth for ornament and use.

In witness whereof I have hereunto set my hand and caused the seal of the United States to be affixed.

Done at the city of Washington this 31st day of March, in the year of our Lord one thousand nine hundred and twenty-two, and of the independence of the United States of America the one hundred and forty-sixth.

WARREN G. HARDING.

By the President:
CHARLES E. HUGHES,
Secretary of State.

SOME SUPPLEMENTARY READINGS WHICH MAY BE USEFUL TO THE TEACHER

A few suggestions for supplementary readings out of the growing literature on trees, forests, and forestry are listed below, and will probably be found in most city or town libraries:

FALL PRELIMINARY

Selection	Author	Volume
Studies of Trees	Levison	
The Tree	Björnstjerne Björnson	Nature in Verse.
October's Party		Do.
The Chestnut Burr		Do.
The Tree Book	McFee	
The Kind Old Oak		In the Child's World.
The Chestnut Boys	Towne	Do.
Wait and See	Jarvis	Do.
	Rogers	Trees Worth Knowing.
The Oak	Hill	Days and Deeds.
The Brave Old Oak	Chorley	Do.
The Legend of the Maple	Ogden	Trees in Poetry and Prose.

WINTER PRELIMINARY

Selection	Author	Volume
The Fir Tree	Anderson	Classic Stories for Little Ones.
The Story of the Amber Beads	Andrews	The Stories Mother Nature Told Her Children.
The Little Pine Tree	Bumstead	Nature in Verse.
The Christmas Trees	Butts	Posy Ring.
The Secret of Fire	Cooke	Nature Myths.
Buds	Chase	Buds, Stems, and Roots. Vol. II, Field and Forest Series.
The Snowing of the Pines	Higginson	Golden Numbers.
Why the Evergreens Never Lose Their Leaves.	Holbrook	Book of Nature Myths.
Miss Willow	Kennedy	Nature in Verse.
The Pine Tree's Secret	Poulsson	Classic Stories for Little Ones.
The Little Fir Tree	Stein	Do.
How Coal Is Made	Wiltse	Kindergarten Stories and Morning Talks.

SPRING PRELIMINARY

Selection	Author	Volume
The Lilac	Bates	Nature in Verse.
The Planting of the Apple Tree	Bryant	Trees in Poetry and Prose.
The Maple's Story	Chase	Buds, Stems, and Roots, Vol. II, Field and Forest Series.
Pussy Willow	Douglas	Nature in Verse.
The Tree that Tried to Grow	Lee	Stories from Garden and Field, Vol. V, Field and Forest Series.
	Peabody and Hunt	Elementary Plant Biology.
The Tree	Jones Very	Nature in Verse.

FIFTH-YEAR WORK

FALL TERM

	Kilmer	Trees and other Poems.
	Mosher	Fruit and Nut Trees.
The Oak and the Mistletoe	Pratt	Little Flower Folk, Vol. III, Field and Forest Series.
An October Talk		Stories from Garden and Field, Vol. V, Field and Forest Series.

WINTER TERM

A Taste of Maine Birch	Burroughs	Trees in Poetry and Prose.
Wood	Foster	Elementary Woodworking, Chapter V.
Under the Washington Elm	Holmes	Trees in Poetry and Prose.
Some Famous Elms of New England	do	Do.
The Aspen	Ingeman	Do.
Rhoecus	Lowell	Do.
Trees of History and Mythology	Sheldon	Little Flower Folk, Vol. III, Field and Forest Series.

SPRING TERM

The Merry Greenwood	Kellerhouse	Forest Fancies.
An April Day	Longfellow	
When the Green Gets Back in the Trees	Riley	Arbor Day.[1]
Pine Trees	Ruskin	Trees in Poetry and Prose.
The Pine Tree		Stories from Garden and Field, Vol. V, Field and Forest Series.
A Forest Hymn		Trees in Poetry and Prose.

SIXTH-YEAR WORK

FALL TERM

The Beech Tree's Petition	Campbell	Trees in Poetry and Prose.
A Protest Against Felling the Trees	Wordsworth	Do.
The First Christmas Tree	Van Dyke	

WINTER TERM

	Dan Beard	The American Boy's Handybook of Camp Lore and Woodcraft.
	do	On the Trail: An outdoor book for girls
	do	The Field and Forest Handybook.
Mr. Maple and Mr. Pine	Brier	Trees in Poetry and Prose.
	Dixon and Fitch	The Human Side of Trees.
The Fruit of the Christmas Tree	Kellerhouse	Forest Fancies.
From My Arm-Chair	Longfellow	Trees in Poetry and Prose.
The Maple Tree's Surprise	Mann	In the Child's World.
	Mosher	Our Cone-Bearing Trees.
The American Forests	Muir	Arbor Day.[1]
Winter Trees	Quayle	Nature in Verse.

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[1] By Robert Haven Schauffler, "Our American Holidays" series.

SPRING TERM

Selection	Author	Volume
Wood Notes	Emerson	Arbor Day.[1]
	Fairbanks	Conservation Reader
Useful Birds and their Protection	Forbush	The Utility of Birds in Woodlands, chapter 2.
	Gregson	The Story of Our Trees in Twenty-four Lessons.
Talks on Trees	Holmes	Arbor Day.[1]
	Lambeth	Trees and How to Know Them.
	Lounsberry	Frank and Bessie's Forester.
	Mosher	Oaks and Maples.
	Roth	First Book of Forestry.

[1] By Robert Haven Schauffler, "Our American Holidays" series.

SEVENTH-YEAR WORK

FALL TERM

Selection	Author
Our Wasteful Nation	Cronau.
Forests, Woods, and Trees in Relation to Hygiene	Henry.
The Earth as Modified by Human Action	Marsh.
Street Trees (Farmers' Bulletin, 1208)	Mulford.
City, State, and Nation	Nida.
The School Book of Forestry	Pack.
Trees as Good Citizens	Do.
The Tree in Religion and Myth	Philpot.
Town Forests	Reynolds.

WINTER TERM

Trees in Winter: Their study, planting, care, and identification	Blakeslee and Jarvis.
Studies of Trees in Winter	Huntington.
The Sugar Moon	Kellerhouse.
Trees, Stars, and Birds	Moseley.

SPRING TERM

Farm Forestry	Akerman.
Scott Burton, Forester	Cheyney.
Scott Burton and the Timber Thieves	Do.
Scott Burton on the Range	Do.
Field, Forest, and Farm	Fabre.
Farm Forestry (Advanced)	Ferguson.
Economics of Forestry	Fernow.
The Principles of Handling Woodlands	Graves.
The Natural History of the Farm: A guide to the practical study of the sources of our living in wild nature	Needham.
Primer of Forestry: Parts I and II	Pinchot.
The World's Food Resources	Smith, J. Russell.
Agriculture: Its fundamental principles	Soule and Turpin.
An Introduction to Agriculture	Upham.
Elements of Agriculture	Warren.
Practical Agriculture	Wilkinson.

EIGHTH-YEAR WORK

FALL TERM

How the World is Fed: How the World is Housed. Geography Readers: North American	Carpenter.
The Log of a Timber Cruiser	Lawson.
Identification of Economic Woods of the United States	Record.

WINTER TERM

Selection	Author
Lumber and Its Uses	Kellogg.
Wood and Forest	Noyes.
American Woods	Hough.
Identification of Economic Woods of the United States. Principles of American Forestry. Chapter XII. The Uses of Wood	Green.

SPRING TERM

In God's Out of Doors	Quayle.
The Study of Nature: Under the Open Sky	Schmucker.
Forest Trees and Forest Scenery	Schwartz.

NINTH-YEAR WORK

FALL TERM

The Log of the Sun; The Personality of Trees	Beebe.
With the Trees	Going.
Elements of Forestry (Advanced)	Hough.
Getting Acquainted with the Trees	MacFarland.
The Awakening: A Fantasy (of the forest)	MacMechen.
Familiar Trees and their Leaves	Mathews.
Primer of Forestry	Pinchot.
Seeding and Planting in the Practice of Forestry (Advanced)	Toumey.

WINTER TERM

Practical Forestry (Advanced)	Gifford.
The Boy with the United States Foresters	Rolt-Wheeler.
Key to Common Deciduous Trees in Winter and Key to Common Woods	Sargent.
The Sylva of North America	Do.
Forest Trees of North America	Do.

SPRING TERM

The United States Forest Policy (Advanced)	Ise.
North American Sylva (Advanced)	Michaux and Nuttall.
Elements of Forestry	Moon and Brown.
Forest Almanac	Pack.
The Forestry Primer	Do.
The Training of a Forester	Pinchot.
The Fight for Conservation	Do.
The Conservation Policy of the United States	Van Hise.
Forest Resources of the World, Chapter IV	Zon and Sparhawk.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

March 31, 1927

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